THE UNIVERSITY OF ALBERTA

THE ANALYSIS OF A MINING CONTRACT SYSTEM BY MULTIPLE LINEAR REGRESSION

A THESIS

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis titled "The Analysis of a Mining Contract System by Multiple Linear Regression" submitted by Wayne H. Griffin, B. Sc., in partial fulfilment of the requirements for the degree of Master of Science.

ABSTRACT

Records, from a three year period of contract stope mining at the Beaverlodge mine of Eldorado Mining and Refining, are used to develop and test a method of contract system analysis.

This method produces from the contract or production records, reliable, independent and unbiased estimates of the labour and materials content of the contract system elements. It appears that the technique would be of value to any industry where each contract includes mixtures of work units.

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INTRODUCTION

This thesis is concerned with the use of multiple regression techniques to analyze the underground mine production data from the Beaverlodge Operation of Eldorado Mining and Refining. The purpose of this analysis is to determine a basis for evaluation of contract payments.

The Beaverlodge Operation of Eldorado Mining and Refining Limited is located in northwestern Saskatchewan and produces uranium oxide from 1400 tons per day of ore mined almost exclusively by underground methods. Comprehensive descriptions of the property, geology, mining methods and production processes have been provided by the mine staff. (1,2) A longitudinal section and surface plan of the mine is shown in Fig. 1.

The mining method which has evolved to accommodate the high grade irregular orebodies of the mine may be classified as selective cut and fill. Briefly, this consists of breaking and removing successive longitudinal slices from the underside of the orebody, the void left by each removal being filled with hydraulically-placed mill tailings.

The irregular and high grade nature of the ore forces repeated departures from systematic stoping. Exploratory test holes, subdrifting, slashing and raising are common interruptions to the standard break, scrape and fill cycle. In other flatter and irregular orebodies, problems of ore removal and filling cause retention of

several slices of broken ore before filling. Thirty to forty stopes, distributed throughout the mine, are required to maintain production.

The usual operating crew for a stope is comprised of two miners on each shift working on piece-work rates. Mine supervision and the geological staff control the grade, mining methods and material supply by daily inspection, but the workmen are mainly responsible for work methods and material usage.

Piece-work payments are administered under what is essentially a sub-contract system. At the end of each month the work done in the month is measured and converted to dollars by means of straight-line rate factors. The sums of these converted dollars are credited to the workmen and a debit is made for total hours worked and also for some of the material used. The credit balance, if any, is paid in dollars to the workmen in proportion to the hours worked. Records of each month's measurements and calculations for all stopes have been retained since the beginning of mining operations.

Over forty different types of work are recognized in the contract system. Of these, thirty three which comprise 99% of the records have been retained for analysis. Some nine more recorded values such as material used and time spent have also been retained.

At first glance it would seem that contract records make analysis of stoping production a simple matter. The number of tons produced divided into the total contract payment plus basic wages gives an overall dollar per ton cost figure for each stope. Assignment of this overall cost to individual types of work done in the

stope is more involved but can be estimated by proportioning the total cost among measurements of the production, according to work classifications, using the rate structure. In this manner, one could obtain a unit cost per ton for each type of work. These unit cost figures with their dependency on unit contract rates can, however, be misleading. If the individual contract rates do not accurately reflect individual unit labour and materials content, then one has an invalid analysis. A type of analysis is required which will provide a valid estimate of the labour and materials content of production.

Administration of the piece-work system is intimately related to stope productivity and costs. Maximum productivity and minimum cost can be maintained only by a set of just and equitable contract rates. Rates are only equitable when they reflect, as closely as possible, the labour and controllable material content of all production. Rates are just only when they have been estimated by a valid and controllable method. A further problem that is a constant concern of administrators is the assessment of modifications in the mining methods. Proper evaluation of contemplated modifications can only be made when accurate estimates of the labour and material contents of present methods are available.

The normal method for estimating labour and materials cost for each type of job is by time and method study of actual work. This method has been employed extensively at Eldorado. The results from studies in single-job production work, such as development, have been gratifying. Results from studies of stope work also have shown some

promise. However, with such a large number of job types within a wide spectrum of conditions, development of timely and accurate estimates of unit production rates has been extremely difficult. If one could obtain such estimates rapidly and accurately from contract records, ore production (which is the central concern of the mine) would be much more amenable to administrative analysis and control. The major concern of this thesis will be the resolution of this problem. An attempt will be made to estimate from contract records reliable and accurate rate factors of labour and material requirements for individual stoping jobs which can be used in the administration and control of contract stoping.

PREVIOUS INDUSTRIAL USE OF REGRESSION ANALYSIS

The application of analytical statistics to engineering and management problems is of recent origin. Techniques which agriculture and biology have used for years have just recently been applied in the fields of engineering and management. The lack of problems or data has not been the major cause for this disparity. The opposite has generally been the case. Such a large quantity of data is generated by modern business practices that only the advent of the digital computer has allowed effective analysis of this data. This condition probably explains why a text by Tippet in the early forties, and later re-edited by Lyle (3) has not received wider usage.

Closer to the present (1960-1964), several articles (4,5,6) have been published on the industrial use of regression. Campbell (4) compares the tool of regression analysis to that of a microscope in medicine. With it, facts hidden in the mass of modern business data can be resolved sufficiently for action to be taken. W. B. Glassford (5, 6) gives a number of concrete examples where regression analyses were used to construct incentive rate systems. Regardless of the title, the article's claims for regression are modest and Mr. Glassford's methods of hand computation can be easily applied in problems of small dimensions.

Extensions of regression and related multivariate techniques have, with the advent of the digital computer, become quite numerous in the mining industry (7, 8, 9, 10, 11). All these applications in

the industry to date have been mainly concerned with sampling, material properties and reactive processes. In most mining operations, materials and processes are the most tractable and predictable factors. The intractable, unpredictable and often highest cost items are usually due to labour. Further extension, therefore, of proven statistical techniques for analysis of mining labour production data should be of value to the industry.

THEORY

The major objective of a production contract system is the evaluation of the skill and effort which workmen employ in the productive process. Monetary evaluation, given for skill and effort, is returned to the workmen as incentive pay or bonus. The usual method of evaluation is based on a measurement system under classified conditions for a set period of time. Units of production measured are converted to monetary credit, and time worked is debited, by a function operating on the measured values. Workmen are paid the positive balances while negative balances are absorbed by the employer.

The method of conversion of units of work to units of value used at the Beaverlodge Operation of Eldorado Mining and Refining up to 1964 was a simple linear equation. Rates, in dollars per unit produced, were constant throughout the range of production, type of mining and location of the working place in the mine. The method of debiting time worked has also been constant and linear. (A very small amount of labour has been charged at \$1.40 per hour but the major part has been charged at a constant rate of \$1.56 per hour.)

This system, with its mine-wide, time-constant application, implies that productivity is constant in time and place. The linear nature of the function implies that production units are independent both of each other and of the level of production. It would be desirable to know if these implications are true, and if the "best"

functions have been used for the desired evaluation. To solve this problem one must first define what is meant by "best".

When measuring a variable (the skill and effort of workmen certainly is variable) by use of one or more indicators, the usual method is to observe simultaneous occurrences of the dependent variable and its proposed indicators (independent variables). From these observations one constructs mathematically, graphically, or intuitively a function which operates on the independent variables to predict (fit) the dependent variable. The differences between the predicted values and the observed values of the dependent variable within the set of observations are now used to evaluate the constructed function. One may use several separate criteria of evaluation such as the minimum sum of the absolute value of this difference or residual, or minimization of the maximum residual value. The criterion however which is the most tractable mathematically and generally used is that the sums of the squares of the residuals shall be a minimum. Throughout this work the minimum sum of squared residuals; i.e. the least squares criterion, will be considered the "best" method of "fit".

The residual value from a least squares "fit" of function to observations has a second and very important statistical use. If the frequency distribution of the residual values can be considered normal with a mean of zero and independent variance then one has exact methods for attaching probability statements to the estimates.

The contract system of computing payments and costs, which is a linear function used to measure or predict the skill and effort of workmen, can be compared to any other function applied to the same set of observations. The comparison can be made at two levels, the form of the functions, and, if the functions are the same, the parameters within the functions.

Let it first be assumed that the forms of the functions to be compared are identical. A function containing the observed independent variables (production unit measurements) of the contract system will be fitted to the observed hours worked (dependent variable). If the estimated function is able to predict the dependent variable with a significant reduction of its variance (analysis of variance tests) then we shall conclude that the form of the function is valid. One can next compare the parameters of the function with those given as contract rates. If the absolute difference between the given rate and that estimated is greater than that which could be attributed to one chance in twenty (95% confidence limit) then one can say that the given contract rates are biased or not "best".

The above assumes that the residuals will not be significantly different from the foregoing normal and independent specification. If this criterion is not met then the probability statements on form and parameters will lose a measure of exactitude, the amount of loss being somewhat determinable by the level of the statistics used to test the normality.

The problem can be formulated using two differing but related models. The direct approach using a form of function like the given system may be termed "Labour Content Estimation". The raw estimates of the parameters, in units of hours per unit of production, are analagous to the type of estimates made from time and methods study, the usual method for constructing a contract rating system. A second related method or model attacks the problem indirectly.

The indirect method may be termed "Correction Factor Estimation". If the contract system's intent is to measure the skill and effort of workmen in dollars, then the variations in this dollar total for equal periods of time should be an unbiased minimum. In other words the given criteria of the "best" could directly evaluate the rates used to calculate incentive earnings. Let us consider that contract rates, for production unit values, are scaling or conversion factors to change all measurement units to a common dimension of dollars. Let the mean incentive rate plus the standard contract wage be the contract time-conversion factor. Now estimate a function which will "fit" the dollar earnings, as represented by rate conversion, to the observed earnings as represented by observed contract hours times mean earnings rate. If the estimated function is able to significantly reduce the variance of the earnings per contract an "improved" contract rate function has been constructed. The remaining variance in earnings per contract may be assigned to skill and effort of the workmen and numerous other factors which might affect work rates. The function has only removed variance in earnings due to inequalities in rates

and in this sense has estimated "improved" rather than "best" rates.

If the estimated values of the coefficients of the function are significantly different from 1.00 then we can apply these parameters as multiplicative factors for the past contract rates to produce what would be "improved" rates. Another decided advantage of the coefficients estimated from this model is that all estimates are non-dimensional and can be compared with one another.

Both of the foregoing models can be represented mathematically by:

$$Y = Bo\ Xo + B_1\ X_1 + - \ldots + B_k\ X_k \qquad (1)$$

In the Labour Content Estimation, Model I, Y is the total hours worked in a given contract period in a given working place, X_1, X_2,... X_k are the measured values of the "k" different types of production in the working place, (X_o = 1) and B_o, B...B_k are the rates in hours per unit of the "k" different units. In the Correction Factor Estimation Model II, Y is the contract dollar credit in a given contract period in a given working place, (X_o = 1) X_1, X_2...X_k are the calculated dollar values of the "k" different units produced in the working place, and B_o, B_1, B_2...B_k are non-dimensional factors which qualify the contract rates used to calculate the dollars values of X_k.

The calculation procedure to estimate the parameters of a linear model fitted to observations by the least squares criteria can be illustrated for a three dimensional case. Extension for the "k" dimensions of the model, equation (1), can be made.

Let the model be $Y = B_o X_o + B_1 X_1 + B_2 X_2$ (2)

where $X_o = 1$ and X_1, X_2, are the independent variables and Y the dependent variable. One has N observations ($N \geqslant 3$) and wishes to estimate, from this set of observations, coefficients B_o, B_1 and B_2, which will give the equation of a plane. This plane is to be at that position where the sums of squares of the differences between the predicted dependent variable and the observations on that variable are a minimum. The usual method, partial differentiation, for finding the minimum of a function is applied to the observations according to equation (2) and results in the following simultaneous equations called normal equations.

$$S\ (Y) = b_o N + b_1 S\ (X_1) + b_2 S\ (X_2) \tag{3}$$

$$S\ (YX_1) = b_o S\ (X_1) + b_1 S\ (X_1^2) + b_2 S\ (X_1 X_2) \tag{4}$$

$$S\ (YX_2) = b_o S\ (X_2) = b_1 S\ (X_1 X_2)\ b_2 S\ (X_2^2), \tag{5}$$

where S indicates summation over N observations, Solving by

$$b_o = \frac{D_1}{D},\ b_1 = \frac{D_2}{D},\ b_2 = \frac{D_3}{D} \tag{6}$$

where D is the determinant of the square symmetric matrix formed by the sums, sums of squares and sums of cross products of the right hand side of equations 3, 4, and 5, and D_1, D_2 and D_3 are similar determinants formed by replacing rows 1, 2 or 3 of D with the left hand sides of equations 3, 4, and 5.

It is easily seen that extension of the above procedure to "k" dimensions makes machine computation mandatory. (For this study there were 1275 sets of data with 42 variates per observation). A computer

program prepared by Dr. K. Smillie of the Department of Computing Science, University of Alberta (12) computes the required sums, sums of squares, and sums of cross products from all given observations and transformations made on these variables. From this large matrix a subset is selected as independent variables for regression against a chosen dependent variable. The regression is done in a step-wise additive manner with the calculation of analysis of variance between each additional term added. Control of the order of the regression calculation can be external or may be left to the computer. Computer control, which selects the variables in the order in which they will reduce the percent variance in the dependent variable, was used throughout the following analysis. This order is not necessarily related to the significance of individual coefficient estimates but in this case the trends are generally the same.

Tests of significance on individual coefficient estimates can be made from the standard error of estimate calculated for the coefficient. Other statistics which can be used to evaluate various conditions of the regression and the residual, after all terms have been added, are produced by the program used (12).

Their use, where applicable, is demonstrated in following sections.

DATA - SOURCES, PREPARATION AND PROCESSING

In most experimental work the apparatus used to generate the data is of primary importance and the tools of analysis receive little attention. For this study of mine contracts, controls on the generation of data were nonexistent and the analysis of data is the main concern. For this reason, then, the methods used to sample the data and prepare it for analysis are examined in some detail.

The sample of 1275 contract calculations includes over 35% of all stope contract records for the period Feb. 1962 to Nov. 1964. The contract system under which these records were generated is given under "Stoping Contract Regulations" (Appendix 3, pages 1 and 2). The terminology for various types of stope work is fairly common throughout the industry. Detailed descriptions of the stoping systems and related terms are available in a comprehensive treatment of the mining operation to which reference has been made (2).

The numbering system under which the various contract elements were coded for computation is given in Table 1 (Appendix 3, page 4). It will be noted that the number of contract elements has been reduced somewhat from that provided by the contract regulations. This reduction was made by some grouping and some exclusion during preparation of the records for key punching. Notes taken during this preparation, given in Appendix 3, page 5, describe the nature of this grouping and exclusion. Additional information for classification of the data was obtained from the mine staff. A brief description of

classification schemes is given in Table 2 (Appendix 3, pages 6 and 7). The enumeration of the records in each classification follows (Appendix 3, pages 8, 9 and 10).

The main computer program used in the stepwise multiple regression was a library program of the Department of Computing Science, written for Dr. K. Smillie, by Mrs. W.B. Payne (12). This program is a general stepwise multiple regression program written in FORTRAN IV for the IBM 7040 which has 32,000 words of core storage. Two magnetic tape units are required for intermediate results, and calculations are in single precision arithmetic. A comprehensive description of the program is available in the Department of Computing Science, University of Alberta, Edmonton, Alberta. A key to the portions of this program's output retained for analysis is given in Table 3 (Appendix 3, pages 11, 12, 13 and 14).

A second major program used was the "Autoplot" program (13). This program used the IBM 7040 system to produce a typewriter plot of data. The 7040 produces punch cards which are manually fed to a card-reader/document-typewriter system to produce the final plot. The program is written in the Assembly language of the 7040 system and is under direct control of the system monitor.

Specific programs were written to arrange raw data and the multiple regression output in a form adaptable to the Autoplot program. As these small programs were essentially simple data handling operations particular to the immediate problem no attempt has been made to record and maintain them. Descriptions of their operation given in

following sections should be quite sufficient to allow one to write similar FORTRAN programs.

MULTIPLE REGRESSION PROGRAMS ON DATA AND DATA CLASSIFICATIONS

(A) General Procedure

Experimental procedures for data analysis follow much the same path as those in any other course of experimentation. A sample of the available data is tested against one or more working hypotheses. The results are examined and experimentation continued with larger samples and more precise hypotheses. In conclusion a general function of the variables is proposed and tested by observing the reliability and veracity of the function under specific conditions.

The first tests were made by graphical representation of the data. These tests indicated little more than the complexity of the problem and were followed immediately by regression analyses according to the mathematical models given in Theory.

The first regression tests on a sample of about 50 per cent of the observations were made using the Labour Content Model. The results of this test (14) confirmed the hypotheses that multiple linear regression on contract records would produce reasonable measures of the labour content of individual production units. The remainder of the data were gathered and subjected to a similar computation. Results of this computation are given in Appendix 1 as Program 3.

Program 3 was now examined in detail and the relationships of the estimated labour content coefficients and the rates of the contract system established. A full scale test was now made using the

Correction Factor Model. The output of this test, Program 60, is given in Appendix 2. Comparison of the results of these two tests was made to establish the relationship between the two methods of approach. As was expected, a direct relationship was demonstrated.

The Correction Factor method was used for further analysis of the data according to several different classification systems. The classification systems were as follows:

1. Mining Methods - 6 classes as outlined in Table 2 plus a seventh class made by dividing B type stopes into Fay and Verna areas, the two major operating divisions of the mine.
2. Incentive Pay Levels - all data divided into \$0.50 per hour increments of incentive pay rate.
3. Time Series with a 6 Month Moving Average - all data were grouped into 6 month periods starting February, 1962. Three sets of groups were made so that calculation periods were two months apart.

The results from all the above classifications were compared with the results from a single regression on all data (Program 60) by covariance analysis. This is a method in which one compares the overall variance in the predicted value using a set of classifications with the variance of prediction, using the same model, on the complete data. The results of those tests, given in Tables 6, 7,

and 8 , Appendix 4, indicated quite clearly that all three types of classifications were valid.

A method was now required to compare the parameter estimated in one class with estimates of the same parameters in the other classes within the same classification. Exact statistical methods were contemplated for this task, but a method closer to industrial practices, the control chart, appeared to serve the purpose well and would have a more general appeal. FORTRAN programs were written to take the regression results of a set of classifications and, using the estimated standard deviation of individual coefficient estimates, to construct a table of values representing the 95 per cent confidence limits of this estimate. (As the number of observations in any one class is greater than 70, exact normal theory was used to give 95 per cent limits at 1.96 times the standard error of estimate).

The parameter estimates plotted have also been altered slightly by a weighting function to make them more comparable to the contract rate system and each other.

In the contract system the rates were calculated on a full 8-hour day basis, a part of which, due to travel, lunch, and rest periods was non-productive. The regression model reflects somewhat this non-productive time by inclusion of the B_0 parameter. Now since contract rates have been upward adjusted to allow for the unavoidable inclusion of non-productive time, it seems reasonable that parameters estimated from regression should be treated similarly.

A multiplicative factor consisting of $\dfrac{\bar{X}_{34}}{\bar{X}_{34} - B_o}$ was used to adjust all estimated coefficients.

($\bar{X}_{34}$ represents the mean value of the dependent variable in the regression and B_o the coefficient estimated for X_o in the same regression).

After examination of the results from the regression programs for evaluation of labour variables it appeared that some useable information on material consumption might be extracted from the contract records. As prior work had indicated that all classifications were valid and the plotting method gave a concise illustration for evaluation, it was decided to proceed directly to this step in the analysis. Five separate sets of regression analyses were made under six classifications. The computer outputs are on file (22) and the plots of significant parameters are given in Figures 52-66.

(B) General Tests of Methods

(1) Graphical Representation and Analysis of the Data

For much experimental work the plotting of data in graphical form allows one to infer quite useful and testable functions for further analysis. In this mining contract situation the dimensions of the data, namely 30 to 40 different jobs or types of work, make direct graphical work impossible. To reduce the dimensions somewhat a number of the variables were combined. This was done by a small

FORTRAN program reading the raw data from magnetic tape. The combined variables, subdrifting, ore breaking, slushing, slusher floor, millhole construction and tramming, are the sums of the individual units in each class as grouped in any one observation (contract period). (Table 1 gives a listing of these variables under their respective grouping nomenclature). These six variables and two more, the number of blast holes drilled and the pounds of explosive reported, were plotted against contract hours per contract per month. Four more plots were also made of development footage and tons of ore broken versus blast holes drilled and pounds of explosive reported. The above 12 plots are given in Figures 2-13.

Examination of these plots indicates that graphical analysis is of little quantitative value in this problem. There is an indication that all pairs of values plotted may have positive linear relationships but it would be rather unwise to draw lines to represent those relationships. The best that one can say of this type of analysis is that it clearly indicates the requirements of more sophisticated techniques for any useful solution to the problem.

(2) General Tests on the Multiple Regression Method

A major assumption made to allow the use of regression methods concerns the frequency distribution of the residual. If the residual, the difference between the observed and predicted value of the dependent variable, has a frequency distribution which is random and independent than one may validly apply statistical tests for evaluation of the regression model and its associated parameters.

To allow one to visualize the relationship of predictions to observations and of observations to residuals, ten per cent of the samples of the observed versus predicted values and residuals versus the observations were plotted (Figures 14 and 15), using the Autoplot system (13). The values used for these plots are given in the Reference Data Vol. 1 (15).

Figure 14, of observed versus predicted values, indicates that while the prediction equation may be unbiased (since the number of points above and below the equality line are substantially the same) the grouping tendency around the value of 300 hours per month leaves some doubt as to randomness. The same grouping tendency is also evident in Figure 15, observed versus residual. The grouping tendency in both plots may be ascribed to the fixed time period for contract calculations of one month and the relatively constant crew strength of two men. True non-randomness of the residuals can be assessed by consideration of the distribution of the points of Figure 15. Because there is no apparent tendency for the values of the residual to concentrate about one or more horizontal lines or bands, one can assert that there is no evidence that the residual is not random.

Figures 14 and 15 show no strong evidence that the residual is not independent of the dependent variable. Evidences of dependency of the residual are usually shown in these types of plots by fan shaped or parabolic trends of the points.

For more exact tests on the residuals the summary statistics of these residuals which complete all of Dr. Smillie's programs may be considered. These statistics (see Appendix 2, page 25) have a variety of uses, some of which are not applicable to this case. The statistics applicable here are:

1. Sums, sums of squares, and mean of the residuals.
2. Coefficient of skewness and coefficient of kurtosis of the residuals and their associated standard deviations.

The remaining statistics may be used to test the serial nature of data. These might be used to indicate that the proposed time series and other classifications of the data are valid, but they are much more useful in qualitative analysis of data with higher cyclic tendencies than this material appears to have.

As the value of the mean of the residual in the full set Correction Factor test is 0.00302 (Appendix 2, page 25) the unbiased nature of the regression operation is apparent. The sum of squares of the residual is used later in covariance analyses (Appendix 4) to compare full data regression with that of classifications. The value given here of 0.90350448×10^8 (Appendix 2, page 25) is comparable with that given in the last step of regression of 0.90347647×10^8 (Appendix 2, page 24, line 36). The value calculated from the residuals is, however, somewhat more accurate than that calculated in the repeated matrix inversion of stepwise multiple regression.

The coefficients of skewness and kurtosis are calculated from the third and fourth moments of the distribution of the residuals. If the distribution were normal they should not be significantly different from zero and 3.0. Testing both these statistics with their given standard deviation it is seen that the distribution is positively skewed and somewhat less peaked (kurtotic) than that which can be ascribed to sampling error.

In general then we find from test of the residual that unqualified acceptance of normality and independence is not valid. If the periods of measurement had been random rather than fixed and the number of workmen more varied it is quite possible randomly sampled observations would have produced more exactness in the results. One must, however, make the best of what is given.

The effects of non-normality on the results of analysis of variance and other related tests have been investigated by a number of authors (16, 17).

It appears that, with the degree of non-normality present in these results, the precision of confidence limits are decreased slightly but not below usable levels. When a statistic has a confidence interval of 95 per cent this interval actually may be as high as the 97 per cent or as low as the 93 per cent limits. Further examination of particular parameters and their associated use will show that this level of precision is sufficient for the problem at hand.

(3) <u>Multiple Regression - Labour Content Estimation</u>

<u>Model I</u>

Model I is characterized as follows:

$$Y = B_o X_o + B_1 X_1 + \ldots + B_k X_k$$

Where Y = Total contract hours per contract per month

$X_o = 1$

$X_1, X_2 \ldots X_k$ = The values of the "k" different types of production measured in each contract

$B_1, B_2 \ldots B_k$ = The contract hours per unit of production measured

The results from the full scale test of this model using all the data (1275 observations) are given in Appendix 1. This computation was a stepwise regression analysis, as outlined in Theory, on variables 1, 2, 3, . . . 29, 30, 32, and 33. (Specific descriptions of these job types are given in Table 1). Production unit 31 was not included as only one value for this unit was present in the observations.

In selecting the regression step (Step 31) which produced the "best" equation the following statistics were used as selection criteria:

1. The "F" ratio of the mean square for regression and the mean square for error of the analysis at all stages of regression was highly significant. This ratio and the probability that a value as great as this could occur by chance are given in columns 4 and 5

of the analysis of variance following each regression step. Examination of Program 3 (Appendix 1) shows that "F" ranges from 1162.8 at step 1 to 210.76 at step 32. The probability function of this value however is always 0.00000. One can therefore assert, with almost complete certainty, that the regression function at all steps is valid by analysis of variance test.

2. The quantity "tn," being the ratio of the difference of sums of squares for regression at step "n" and step (n-1) and the mean square for error at stage "n," which measures the contribution of the variable X_n to the regression after variables X_1, X_2, ...X_n-1, have been added, ~~were~~ was used to decide which step of regression to be used as a working equation. This value (tn) is distributed as "t" but may be considered as an exact normal distribution. Any values therefore of "tn" greater than 1.96 indicate that the addition of variable X_n has a significance greater than 95 per cent. In Program 3 we see that "tn" (line 4, column 5, of the analysis of variance tables) decreases suddenly to a non-significant value of 0.08. Step 32 of the regression analysis is therefore disregarded and Step 31 accepted as the working equation.

3. A second statistic which is related to "tn," the sum of the percentage of variance reduction, also indicates that Step 31 should be the working equation. The values for Steps 29 through 32 are 84.38, 84.42, 84.45 and 84.45. As Step 32 of regression does not reduce the variance of the dependent variable below that of Step 31 the use of this added dimension is superfluous.

4. Examination of the coefficients of the chosen regression step (No. 31, Appendix 1, page 23) in detail now was done. The statistics used were the "$t_{a(31)}$" values. This value, the ratio of the estimated coefficient divided by its standard deviation, is distributed as "t" with N-n-1 degrees of freedom and may be used to test a coefficient for a significant difference from zero. Again, with over 1200 degrees of freedom, values less than 1.96 indicate that there is more than a 1 in 20 chance that the true coefficient could be zero. Of the 31 $t_{a(31)}$ values given (Appendix 1, page 19), it was seen that only those for variable 32 (Miscellaneous Timber - $) and 29 (Miscellaneous Development) are below this value. Considering that these $t_{a(31)}$ values (1.75 and 1.50) were only slightly below the 95 percent level the retention of these coefficients seemed reasonable.

5. A final examination of the 31 coefficients showed that all estimated values were positive. There are no restrictions in the model or the computational procedure against negative coefficients but the practical conception of a negative time per production unit would be most difficult in any mine contract system. The results are thus realistic from this point of view.

From the above criteria then the following equation is selected as "best" under the Labour Content Model:

$$\begin{aligned}\hat{Y} = {} & 92.35 + 1.90\ X_1 + 1.78\ X_2 + 1.60\ X_3 \\ & + 1.65\ X_4 + 2.43\ X_5 + 1.50\ X_6 + 0.149\ X_7 \\ & + 0.114\ X_8 + 0.0803\ X_9 + 0.0608\ X_{10} \\ & + 0.135\ X_{11} + 0.0866\ X_{12} + 0.0822\ X_{13} \\ & + 0.0559\ X_{14} + 0.0271\ X_{15} + 0.0165\ X_{16} \\ & + 2.90\ X_{17} + 3.97\ X_{18} + 0.0911\ X_{19} \\ & + 0.0376\ X_{20} + 0.923\ X_{21} + 0.235\ X_{22} \\ & + 0.221\ X_{23} + 0.741\ X_{24} + 0.550\ X_{25} \\ & + 0.130\ X_{26} + 0.0251\ X_{27} + 0.0679\ X_{28} \\ & + 0.828\ X_{29} + 0.221\ X_{30} + 0.161\ X_{32} \qquad (7)\end{aligned}$$

The dimension of Y is contract hours and the coefficients are in dimensions of contract hours per production unit. The values are given to three significant figures as that is the normal measurement significance of production units. The notation $\hat{Y}$ is given rather than Y to indicate that this is a predicted value for total contract hours per contract rather than an exact mathematical value.

To compare the coefficients of the above equation with the linear equation represented by the contract system rates, which are in dollars per unit of production, one must convert equation (7) to equivalent dimensions. A second factor that must be resolved, before comparisons can be made, is that the constant of 92.35 hours in the regression equation is not represented in the equation of the contract system. (Constant non-productive time is certainly considered when constructing contract rates from time study methods but in the

given case, rates have been adjusted upward to include this factor).

With the above in mind the following calculations were made on the values of equation 7 and its associated $t_{a(31)}$ values.

(a) Weighting factor, to adjust net labour content estimates to gross or full time values –

Let $\bar{X}_{34}$ = mean contract hours per contract

B_o = estimated constant contract hours per contract

K_1 = constant for multiplicative adjustment of labour content estimates (non-dimensional)

Then $$K_1 = \frac{\bar{X}_{34}}{\bar{X}_{34} - B_o}$$

And for Program 3

$$K_1 = \frac{404.2}{(404.2 \quad 92.35)} = 1.30$$

(b) Conversions of the labour content estimates of hours per unit of production to comparable contract rates of dollars per unit of production -

Let $S(X^1_{ij})$ = the sum of all dollar credits paid to all contracts

Let $S(Y_i)$ = sum of all contract hours worked ($i = 1, 1275, j = 1, 2-...29, 30, 32$)

Then K_2 = weighted mean credit rate = $\dfrac{S(X^2_{ij})}{S(Y_i)}$

Now, as means are summations divided by N, the ratio of two means is equal to the ratio of the summations if the means

are from the same set. We therefore calculate K_2 from the sum of the means of the variates of Program 60 to which dollar conversion factors have been applied and the mean value of X_{34} in Program 3 giving:

$$K_2 = \frac{1445.7}{404.2} = \$3.58 \text{ per hour}$$

(This is the average earnings per hour of all men on contract for the period February 1962 to November 1964). The two factors K and K_2 can now be combined to give an adjusted earnings rate which when multiplied by the labour content estimated for a production unit gives a rate in dollars per hour comparable to the contract rate.

Then R_c (the calculated contract rate)

$$= (K_2) \,.\, (K_1) \,.\, (B_j) \,. = (4.65)(B_j) \text{ dollars/unit}$$

(c) The confidence limits of the estimates must also be adjusted. The fractional method using the t_a statistic is the easiest approach.

As the 95 per cent confidence limits for B_j are defined by $B_j \pm (1.96)\ (S_a)$, where $(a = j)$ and S_a = standard error of estimate or standard deviation of B_j, we may express this confidence limit as a fraction of B_j by K3 =

$$\frac{(1.96)\ (S_a)}{(B_j)} = \frac{(1.96)}{(t_a)}$$

As an example:

$$K_{3(13)} \text{ (for } B_{13}) = \frac{1.96}{17.99} = 0.109$$

Now B_{13} (Program 3 Step 31) $= 0.0822$

Then $R_{c(13)} = (4.85)\ (0.0822) = 0.399$ \$/ton.

The 95 per cent confidence limits for $R_{c(13)}$ are

$$0.399 \pm (0.109)\ (0.399) = 0.399 \pm 0.043 \text{ \$/ton.}$$

By 95 per cent confidence limits it is implied that if we compare $R_{c(13)}$ with the contract rate for Unit 13 and if the contract rate for Unit 13 is greater than 0.442 dollars per ton or less than 0.356 dollars per ton then there is a 20 to 1 chance that the contract rate is biased.

The above calculations were done for all estimates of the full scale Labour Content Model test and are given in Table 4.

Examination of Table 4 indicates that, in general, contract rates have been equitable over the three year period of observations. The rates which are significantly different from those estimated as "best," indicated by an *, comprise a relatively small part of the total time. One also must appreciate that the analysis has been made on data from a relatively long time period which may include some out of date conditions. Before any change of rates is made on the basis of this analysis one should determine if the apparent inequalities of rates are operative at the present in all methods of mining.

TABLE 4

COMPARISON OF LABOUR CONTENT ESTIMATES AND CONTRACT RATES

Variable No.	Description	Rc($/unit) Rate Calc. from M. R. A.	95% Conf. limits of Rc ± $/unit	Contract Rates Given $/unit	Unit of Measure
1.	Credit time	8.85	1.18	1.56**	hours
2.	Subdrifting 0' - 50'	8.36	1.10	6.90*	feet
3.	Subdrifting 50' - 100'	7.45	1.18	7.40	feet
4.	Subdrifting 100' - 150'	7.67	1.76	7.30	feet
5.	Subdrifting + 150'	11.30	4.41	8.40	feet
6.	Stope Raising	6.98	2.09	6.40	feet
7.	Breaking 4' - 6' widths	0.70	0.24	0.67	tons
8.	Breaking 6' - 10' widths	0.53	0.06	0.48	tons
9.	Breaking 10' - 20' widths	0.37	0.05	0.42	tons
10.	Breaking + 20' widths	0.28	0.05	0.39**	tons
11.	Slushing 5 HP air	0.63	0.19	0.60	tons
12.	Slushing 10 HP air	0.40	0.60	0.50**	tons
13.	Electric Slushing	0.38	0.04	0.40	tons
14.	Second Slush	0.26	0.08	0.20	tons
15.	Slusher Floor 0' - 7'	0.13	0.04	0.12	sq.ft.
16.	Slusher Floor + 7'	0.08	0.02	0.10	sq.ft.
17.	Cribbed Millhole	13.50	3.14	15.00	feet
18.	Stulled Millhole	18.45	4.03	13.50*	feet
19.	Gob Fence	0.42	0.10	0.30*	sq.ft.
20.	Hangingwall Fence	0.17	0.07	0.30**	sq.ft.
21.	Test holes	4.24	3.46	0.75*	each
22.	Rock Bolts W/Plate	1.09	0.70	2.50**	each
23.	Rock Bolts No Plate	1.03	0.98	1.25	each
24.	Posts	3.44	2.14	2.50	each
25.	Cribs	2.56	2.54	3.00	feet
26.	Bulkhead	0.60	0.32	0.40	sq.ft.
27.	Tramming	0.12	0.05	0.15	tons
28.	Muck & Tram	0.31	0.08	0.38	tons
29.	Misc. Development	3.85	5.05	1.00	dollars
30.	Misc. Breaking	1.03	0.59	1.00	dollars
31.	Misc. Timber	0.75	0.84	1.00	dollars

NOTE: * indicates rates differing beyond the 95% limits
** indicates those beyond the 99% limits

An answer to the above is attempted in subsequent regression analyses on subsets of the data.

(4) Multiple Regression - Correction Factor Estimation

Model II

The results of the full scale test (Program 60) of this model on all the data (1275 observations) are given in Appendix 2. The independent variables in this model are derived from the same raw data as used in the former labour content estimation model by multiplication with the contract rates. The factor used to convert the observed contract hours to dollars was \$3.6025/hour. This factor was estimated from a number of trial runs and represents a weighted mean earnings rate per observation (contract calculation). This rate is somewhat greater than the mean of bonus rates (see variable No. 41 Appendix 1, page 1) plus the standard contract wage debit rate of \$1.56 per hour. Some of this descrepancy can be attributed to penalty charges but it is quite possible that contract calculations with high total hours have tended toward higher bonus rates. This should be expected as the larger more stable contracts would tend to attract the senior and more skilled workmen.

Examination of the output of Program 60 shows that while the coefficients estimated differ from those of Program 3 the statistics used to evaluate the regression and the parameters within the regression are exactly the same as those of Program 3. The reason for this apparent incongruity is that statistics such as means and regression

coefficients are absolute values while test statistics such as the "F" ratio, percent variance reduction, "t_n" and "t_a" are calculated from ratios in which multiplicative factors, applied to the data, cancel.

In order to demonstrate that the two methods of approach are equivalent, a method was developed to produce contract rate correction factors from the estimates of Program 3. The assumption behind this method is that, if given a set of just contract rates, the percent of time spent in producing any given measured units should be equal to the percent of money paid for this production. The calculation method follows for the results which are tabulated in Table 5.

(i) Distribution of dollar credits for each unit "j" of production as a percent of total contract credits:

$$= \frac{\bar{X}_j^1}{S\ \bar{X}_j^1} \quad (100)$$

where X_j^1 is the mean of the "j" transformed variable in Program 60, and S indicates summation over all the means in the same set.

(ii) Distribution of time for each unit "j" of production as a percent of total contract time:

$$= \frac{\overline{X}_j}{S(\overline{X}_j)} \quad (k_1)\ (100)$$

Where $\overline{X}_j$ is the mean value for unit "j", and "S" indicates summation of over all means, and k_1 is as defined for Table 4 calculations.

(iii) Correction factor calculation from Program 3

= % mean time ÷ % mean credits

(iv) Correction factors calculated from Program 60

$$= (B_j^1) \left(\frac{\overline{X}_{34}^1}{\overline{X}_{34}^1 - B_o^1} \right)$$

Where B_j^i is the regression coefficient from Program 60, Step 31, and $\overline{X}_{34}^1$ is the mean value of the total dollar credits, the dependent variable of Program 60.

(v) The percentage confidence limits shown in the last column of Table 5 are derived directly from the fractional confidence limits.

(5) <u>Comparison of Results from Model I and Model II</u>

Examination of correction factors calculated from the two regression models (Table 5, columns 3 and 4) shows that they produce almost identical results. Except for rounding errors the

TABLE 5

COMPARISON OF LABOUR CONTENT ESTIMATION

AND CORRECTION FACTOR ESTIMATION

Variable No.	Description	% Total Credits	% Total Time	Calc. Corr. Factor Prog. 3	Corr. Factor Prog. 60	95% Limits as %
1.	Credit Time	0.6	3.7	6.17	5.70	13.3
2.	Subdrifting 0 - 50'	5.8	6.9	1.19	1.21	13.1
3.	Subdrifting 50' - 100'	4.6	4.6	1.00	1.01	15.9
4.	Subdrifting 100' - 150'	1.7	1.7	1.00	0.97	23.0
5.	Subdrifting + 150'	0.4	0.6	1.50	1.35	39.4
6.	Stope Raise	1.0	1.1	1.10	1.09	30.0
7.	Breaking 4' - 6'	1.2	1.2	1.00	1.04	33.7
8.	Breaking 6' - 10'	16.9	18.3	1.08	1.11	11.4
9.	Breaking 10' - 20'	7.1	6.3	0.83	0.89	14.7
10.	Breaking + 20'	6.2	4.5	0.73	0.73	17.3
11.	Slushing 5 HP air	0.8	0.8	1.00	1.05	31.2
12.	Slushing 10 HP air	3.0	2.4	0.80	0.81	22.6
13.	Electric Slushing	24.9	23.6	0.95	0.96	10.9
14.	Second Slushing	1.4	1.8	1.29	1.30	30.5
15.	Slusher Floor 0' - 7'	1.8	1.9	1.06	1.05	27.3
16.	Slusher Floor + 7'	2.5	2.0	0.80	0.77	29.6
17.	Cribbed Millhole	3.9	3.5	0.90	0.90	23.2
18.	Stulled Millhole	1.7	2.3	1.36	1.37	21.8
19.	Gob Fence	1.7	2.4	1.41	1.42	25.3
20.	Hangingwall Fence	2.6	1.5	0.58	0.59	42.5
21.	Test Holes	0.1	0.6	6.00	5.75	82.0
22.	Rock Bolts/Plate	1.4	0.8	0.57	0.56	64.1
23.	Rock Bolts No Plate	2.2	1.4	0.60	0.64	95.5
24.	Posts	0.5	0.8	1.60	1.38	62.2
25.	Cribs	0.3	0.3	1.00	0.86	39.6
26.	Bulkhead	0.4	0.7	1.75	1.51	54.2
27.	Tramming	2.6	2.0	0.77	0.78	39.1
28.	Muck & Tram	2.1	1.8	0.86	0.83	25.5
29.	Misc. Development	0.0	0.0	--	3.87	132.0
30.	Misc. Breaking	0.3	0.3	1.00	1.03	52.3
31.	Misc. Timber	0.3	0.2	0.75	0.75	112.0

factors are the same, and as the $t_{a(n)}$ values are identical the same nine production rates "1, 2, 10, 12, 18, 19, 20, 21 and 22" appear inappropriate. It can therefore be concluded that regression analysis Model II is a valid method to use for analysis of this data. The advantages of this method over Model I are apparent when the calculations required to produce Tables 4 and 5 are considered. Whereas Column 3 of Table 5 requires several steps of multiplication and summation, Column 4 of Table 5 consists of only one multiplicative step beyond that given in the computer output. As the raw estimates in Program 3 are in several different units, direct intercomparison of estimates is impossible. In Program 60 all raw estimates are in the same units and one can easily compare pairs or larger sets of estimates directly. A number of multiple range tests are available (18) for this type of comparison.

(C) Further Test to Establish the Effectiveness and Reliability of Model II

(1) General Requirements for an Effective Contract Administration Analysis Tool

It has been demonstrated in the foregoing that an analysis method is available which appears to give a reasonable and unbiased evaluation of the past three years contract data. It must now be shown that this method would be applicable to present and future administration and control of this contract system.

The major question that arises in the consideration of any contract system is the equity of the rates. The level of incentive pay, the classification of units, the type and timing of measurement and the methods of calculation are generally fixed over relatively long periods of time. The contract systems are usually constructed so that changes in work methods and conditions can be reflected in rate changes. Obtaining an unbiased and controllable measure of what these changes should be has always been a problem. The coefficients from the Correction Factor multiple regression give unbiased estimates of a multiplicative factor for rate correction. More important, these estimates have measures of reliability, which is more than can be said for many time study methods.

A further question of application of these estimates is dependent upon stability. The data used in Programs 3 and 60 covered slightly less than three years operation. The estimates can be thought of as mean corrective factors that could have been applied over this period and should be applied for further work if conditions remain the same.

No reasonable administrator attempts to foretell the future exactly. The best he can hope for is to note from the immediate past that conditions are changing and then try to discover what is causing the change by use of judgement and intuition distilled from experience. With the above in mind one can appreciate the value of time series classification for analysis using Model II.

If conditions and work methods, as analysed by Model II, appear sufficiently stable in time, for control purposes one still must investigate other areas of possible instability. It is possible that the contract system's assumption that work conditions are relatively equivalent could be in error. A number of regressions with the data classified according to differing work methods should allow a test of this assumption.

A third factor, relative incentive rate, may also be operative in work rate stability. Are the work rates of workmen who consistently earn better than average incentive rates relatively different than those of low and average incentive? Rate classes should answer this question.

The same model as used in Program 60 is used to test the above three questions of stability. The methods of classification have been given in Table 2. (Appendix 3, pages 6 and 7). The computer outputs for these calculations were bound and are on file at the Department of Mining and Metallurgy, University of Alberta, Edmonton, Alberta (19, 20, 21). Covariance analyses to determine the validity of the classifications are given in Appendix 4.

Examination of the covariance analyses indicates quite definitely that all three classifications are valid. The large "F" ratios indicate that the reduction of variance by classification is very much greater than that which could be attributed to chance.

(2) Organization of Results of Class Regressions for Comparative Analysis

The thorough analysis of large quantities of data is often a problem to the experimenter and the administrator. Tabular lists of figures as produced directly by computer are only comprehensible to a degree. With a computer's facility for producing these tables one is easily led to produce such a confusion of figures and details that the solution is more confusing than the problem. Examination of the computer results from regressions on a few classifications indicated that the likelihood of this type of confusion was high. As a method of condensing results from a large number of regressions was required, it appeared that the Autoplot system (13) offered the best solution.

A FORTRAN program was written to accept the parameters of selected sets of regressions and present them to the Autoplot system in a form similar to industrial control chart methods. The coefficient estimates, (central line on the plots) were pro-rated to a full time basis in the same manner as the coefficients in Table 4. The weighting factors varied from 1.1 to 1.3. However, the confidence limits (outer lines on the plots) were calculated from 1.96 times the <u>unweighted</u> standard error of estimate of the coefficient and hence do not represent a 95 per cent confidence band but a band of 85 per cent to 95 per cent confidence.

The step of regression chosen as a working equation for plotting was selected using the t_n statistic as the major selection criterion. As the classification regression sets are made up of smaller numbers of observations than the full set, the selected number of significant coefficients is always less than that of the full set. It was found that t_n values generally decreased sharply below 1.96 at the 24th to 28th step of regression.

The combination of all valid regression coefficients in a number of plots (one for each production unit) indicated that in a number of cases estimates for the coefficient did not appear in all regressions. It was decided therefore to retain only those plots in which at least 75 per cent of all classes were represented. The regression data from which the plots are made is on file as reference in the Department of Mining and Metallurgy, (19, 20, 21).

The scales on these Autoplot graphs may at first glance be confusing as they are given in exponential form. Note that on the left of the axes one or two numbers are given preceded by a sign and a letter "E." This represents the power of 10 by which a particular scale is multiplied to produce its true value. For example Figure 50 has E-01 above the horizontal and left of the vertical axis and also below the horizontal and left of the vertical axis. These values indicate that both scales should be multiplied by 10^{-1}.

In consideration of these plots one must appreciate that the only true data points are at the classification points and all other points have been produced by straight line extrapolation between contiguous classifications. In the plots of time classification and in the incentive rate classification plots this extrapolation allows one to visualize trends. In the plots of mining method classification however one should regard the extrapolation as extraneous and visualize the plots much the same as a bar chart.

In interpretation of the plots, in the following sections, reference will be made to productivity increases or decreases, as shown by the fluctuations of the correction factor. When the correction factor for a contract rate is above 1.00 productivity can be said to have decreased below that implied by the given rate. Similarly when the factor falls below 1.00 one can say productivity has increased.

(3) <u>Analysis of Individual Parameters within Classifications by Means of Control Chart Methods</u>

(a) <u>Classification on the Basis of Time Intervals</u>

A six month moving average calculated at two month intervals is used. This method was chosen to obtain a balance between the poor estimation that could result from the fewer observations in a shorter period and the lack of variation in longer periods. If this type of analysis were to be applied as a control method several test analyses should be done with varying length periods to ascertain the method most applicable to the available data and methods of control.

The plots produced by this method of analysis generally show good evidence of regularity. The overlapping method of classification would produce some smoothing but it appears that an overriding evidence of stability is present. Another factor which reinforces the conclusion of stability is the small variation in the confidence band widths. With unstable estimates one would also expect the standard deviations of the estimates to fluctuate wildly.

This type of analysis, time series classification, is meant to simulate the method a contract administrator would employ on a routine monthly basis. In a real situation the administrator would be in intimate contact with the system and should have much pertinent information for the explanation of fluctuations. The author has had some association with the system under analysis and will put forward some causes of fluctuations to illustrate the method's use but one must appreciate that fuller use of the method could be made by those who were directly concerned with the real system.

(i) <u>Mean Bonus Rate and Mean Contract Hours vs Time</u> Figures 16 and 17

These mean values were plotted with the thought that they might help explain some of the fluctuations in the regression estimates. If a decrease in the work rate, for a production unit, accompanies an increase in bonus rate, a reduction in contract rate would be somewhat validated.

The general appearance of each plot suggests that productivity has shown a general improvement over the three year period. The number of contract hours per contract also shows evidence of seasonal trend. This could be a reflection of variation in work force due to seasonal holidays.

(ii) Percent Variance Reduction, Weighting Factor and Mean of Dollar Credits vs Time - Figure 18

These three factors appear in Figure 18 from top to bottom as listed above. The Weighting Factor has been multiplied by 100 and the Dollar Credits divided by 10. Percent Variance Reduction is in true scale and is a measure of the validity of the regressions throughout. The Weighting Factor is a measure of the constant in the regression and may be thought of as a measure of the non-productive contract time. The Mean Dollar Credits are a direct measure of mean total contract hours per contract, as a constant multiplier ($3.6025) was used to convert the value of observed total hours to dollars.

The Variance Reduction plot shows good stability and indicates that all regression equations were highly significant. The values for this parameter between 90 per cent and 79 per cent are quite comparable to that (84.5%) obtained from the complete set of data (Program 60, Appendix 2, page 23).

The Weighting Factors which were applied to all coefficients in each regression appear somewhat less stable, but except for one point all values are between 1.18 and 1.45.

The mean value of dollar credits give a smooth curve with a maximum in the last half of 1963. This could indicate relatively larger crews on contracts in this period or it could be caused from increased productivity.

(iii) Credit Time - Correction Factor vs Time
Figure 19

The plot of the correction factor for Credit Time is relatively smooth. It shows however, a wide range of values (2.0 - 9.0). A probable cause for this fluctuation might be attributed to the administration of this factor. Credit time was originally meant to be paid for types of work for which no contract rates had been set. Supervisors were to estimate the time the workmen spent doing this work and give sufficient credit hours at $1.56 per hour to return average incentive rates. Often, however, credit time may have been confused with non-contract time which was to be applied only when the workmen, due to causes beyond their control, were not able to produce.

The overall effect of this improper allowance may have been to penalize the workmen for doing non-standard work. The effect, however, would not be great, as mean credit time comprises less than 1.0 per cent of mean Credits. It is also gratifying to note that 5.70, the factor estimated with all the data (Table 5, Column 4,line 1) is very near the mean of the plotted values. From the foregoing one could suggest that, rather than change the rate for credit time, a clarification of administration policies would materially assist in correction of this anomaly.

(iv) Development Correction Factor vs Time
Figures 20 - 24

Overall examination indicates that development rates are equitable since most confidence bands enclose 1.0 throughout. Subdrifting 0' - 50' from the mill hole shows some trend to higher productivity while similar work 50' - 100' from the disposal point trends in the opposite direction. Investigation of these production units could be in order. Equipment allocation and/or work methods are likely causes of the trends.

(v) Ore Breaking Correction Factors vs Time
Figures 25 - 28

The non-continuity of the factors for 4' - 6' widths (Figure 58) is to be expected as very few stopes are mined at this width alone. The correction factor for the major production width of 6' - 10' (Figure 26) is continuous and has a relatively narrow confidence band. A definite low in productivity late in 1962 is followed by a regular increase to the end of 1964. The other two categories of 10' - 20' and + 20' widths also show this increasing productivity trend. An investigation of work methods and equipment changes for all ore breaking work may be in order. Changes of rates to reflect changes in productivity of these units could have a marked effect on contract costs as they account for over 31 per cent of costs.

If one compares the time of increasing productivity in these major breaking variables with the time of increase in bonus and decrease in contract hours (Figures 16 - 17) it seems that work methods in ore breaking have been improved toward the point where mine management should be recovering some portion of the improvement.

(vi) <u>Slushing Correction Factors vs Time</u>
Figures 29 - 32

All figures except No. 31, electric slushing, show wide confidence bands that enclose the value of 1.0. Hence no change of rates seems warranted. Electric slushing, the major production variable in the contract system, (24 per cent of costs), shows (Figure 31) indications of increasing productivity.

Changes of rates for this job could have a decided effect on contract costs and should be investigated closely.

(vii) <u>Timbering Correction Factors</u> - Figures 33 - 37

The plots of the two types of slusher floor (Figures 33 - 34) show their proper position in time. Work methods were altered in 1963 and a lower rate was established. It appears that even with the reduced rate much of the profit from improvement in the method has accrued to the workmen.

Millhole construction (Figures 35 - 36) shows that while cribbed millholes have been overpriced, stulled millholes have been underpaid. Changes in these rates would loom large to the workmen but would have little effect on overall costs.

The remaining factor plotted in this series, Gob Fence (Figure 37), shows indications of overpricing in the past but is in line with rates at the present time (1964).

(b) Classifications on the Basis of Methods of Work

Correction factors for each unit of production were plotted against work method classification. The arrangement of the work method classes in the plots is somewhat toward increasing irregularity but is in no sense gradational. While the irregularity in ore bodies has dictated some pecularities of each method many more factors have been considered in the selection of a particular mining system. In examining the plots, one should regard extrapolation between classes as a visual aid only and not an intimation of continuity.

It will be noted that the confidence bands tend to widen for D and E classes of stopes. As the number of samples in these classes was only about one third of those in the other classes, a larger variation in estimates may be expected.

Some 50 samples classified as F or S (unclassified strays) were not plotted as this small highly varied sample returned only a few valid estimates.

(i) Percent Variance Reduction, Weighting Factor and Mean Dollar Credits vs Stope Classification - Figure 38

These values are arranged on the plot the same as

similar values were in the time classification plot (Figure 18).

The percent variance reduction graph is regular throughout. The range of 75 per cent to 90 per cent is similar to that of the time series classification, an indication of valid regression functions.

The plot of mean dollar credits indicates that A and B types have had considerably larger total contract payments than other classes. This could be expected as more regular working places are more amenable to double shift operation.

The Weighting Factor is fairly constant around 1.3 except for the C method. The discrepancy is probably a reflection of the lower percent variance reduction in the C method. Overall we can expect that the confidence limits shown on the plots are in the 80 per cent to 90 per cent range.

(ii) Correction Factor for Credit Time vs Stope Classification - Figure 39

This plot shows that the assessment of credit time also varies with mining method. Variations aside, there is definite evidence that this factor has been undervalued.

(iii) <u>Correction Factors for Development vs Stope Classifications</u> - Figures 40 - 42

These three plots offer a possible clue to the recent decreases in sub-drifting productivity noted in the time series analysis. "D" methods of development work definitely have taken more labour time than normal. This type of stoping is also of recent origin and could be the cause of the general decline in development productivity (Figures 21 - 22).

(iv) <u>Correction Factors for Ore Breaking vs Stope Classifications</u> - Figures 43 - 44

It appears the rates for breaking 6' - 10' widths have been equitable throughout the mine. There is some evidence that B and C methods of stoping have easier breaking in larger widths than do the other methods. Work methods and materials here would bear investigation.

(v) <u>Correction Factors for Slushing vs Stope Classifications</u> - Figures 45 - 46

It appears that A and D types of stoping have relatively low productivity in electric slushing while C and E types are relatively high. It is possible that examination of mine equipment would show a higher percentage of 3 drum slushers in places using "C" methods than in those using A and D. The E method of stoping

enjoys the unique advantage that workmen muck and tram slushed ore directly and thus have no delays due to chute hang-ups.

It is interesting to note that while covariance analysis indicates that this classification of data is quite valid fewer continuous estimates were calculated. Because many of the production units are particular to one or two methods of mining, measurements of these units are sparse or missing in many of the classifications and hence did not enter the regression as valid parameters.

It also would have been interesting to reclassify the data under some of the other classifications such as ore control, ground control or breaking characteristics but time did not permit.

(C) Classification on the Basis of Incentive Rate

By this classification, an attempt is made to ascertain whether work rates vary more or less directly with the incentive rates. Do the workmen, who consistently receive higher incentive, work at higher productive rates, on all types of work, or does the rate of change of productivity vary from job type to job type?

The plotted values were obtained from data sorted into $0.50/hr. bonus rate increments. The estimate from the full set regression has also been included and is plotted at $1.84/hr. The inclusion of these

values has destroyed much of the continuity of the plots. Covariance analysis on this classification (Appendix 4, page 3) and percent variance reduction indicate that considerably "better" regression equations are produced by this classification. However, when one considers that incentive rate values are the core of the contract system it is apparent that this classification is an arbitrary truncation of the data which could materially degrade its essential randomness. This degradation could have a decided effect on parameter estimation and nullify any qualification of "better." One therefore, considers the plots more for continuity and trends rather than absolute level of productivity factors.

(i) <u>Percent Variance Reduction and Mean Dollar Credits vs Incentive Rate Classification</u> - Figure 47

The percent variance reduction (the upper line in Figure 47), a measure of individual regression validity, is quite high and is probably caused by truncation of the data. The mean total credits (lower line) show the linear trend which could be expected from the classification method.

A Weighting Factor was used in plotting the variables but was not plotted itself. Examination of the results (21) showed it was nearly constant at 1.3.

(ii) <u>Correction Factors for Development, Breaking, Slushing and Timbering</u> - Figures 49 - 50

All of the estimates in the above categories showed no strong evidence of departure from a straight line. One can conclude

therefore, that the contract rates paid for these production units are relatively equitable throughout the incentive rate range. (Two samples of the 20 plots in this classification are given in Figures 49 and 50).

How can one reconcile the above evidence with former evidence of non-equity in the rate structure? It appears that the mining methods are such that overpriced, equitable and under-priced units of production tend to be distributed evenly throughout the mine. The chances of a contractor consistently producing a surplus of overpriced units hence making consistently higher bonus has been quite unlikely.

(D) Multiple Regression Analysis of Expendable Materials

Some of the materials used in stope production have been recorded in the contract records. It was decided to test this materials data with the methods of regression that were used to evaluate the labour factors to find if similar factors for material use could be obtained. As former regressions for labour content on subsets have been shown to be significant within classes, regressions for material have been done within classes only. Moreover, since materials are herein considered subsidiary to labour content, only the mining method classification was considered for illustration of the method.

The five materials factors recorded in the data were:

1. X36 - Blast holes drilled (fuse count)

2. X37 - Reamed holes

3. X38 - Pounds of explosive as reported by workmen

4. X39 - Pounds of high explosive as calculated by supervisor

5. X40 - Pounds of Amex as calculated by supervisor

(Holes drilled for blasting and reamed holes are here considered as materials because there is a direct relationship between the number of holes drilled and the amount of material used such as drill steel and bits).

All the above five variables were used as dependent in separate regression analyses against all measured production units of jobs in which they were used. The computer outputs of five regressions in all classes of mining methods are given in (22). The results which appeared valid and continuous were put in the Autoplot program in a manner similar to the labour factors.

It was found that only two of the dependent variables were predicted regularly and validly by regression methods. These were:

1. Blast holes drilled

2. Pounds of explosive reported

If the two types of explosive as calculated by supervision could have been additively combined they might have produced a valid regression. As it was, it appears that these two values separately are of little use. A regression with these two as independent variables against holes drilled as a dependent variable could give one an estimation of the loading factor in average pounds of explosive per foot of blast hole drilled.

Regression using the number of reamed holes as a dependent variable was disappointing. The use of reaming in stope development work is apparently much more random than standard practice policies would indicate. On the other hand standard mining practices followed by substandard reporting policies could have been a cause of the above anomaly.

(1) <u>Holes Drilled per Production Unit vs Mining Methods</u>

In general the results of the regressions appear reasonably stable and comparable. While development estimates have wide discrepancies in method A, breaking values are more consistent.

(i) <u>Holes Drilled per Foot of Stope Development vs Stope Classification</u> - Figures 51 - 55

Except for Method A it appears that about 3.5 holes are drilled and blasted per foot of subdrift produced. If one assumes that the normal subdrift is drilled to an 8 foot length and breaks 7.5 feet, one derives a calculated value of 26.2 holes per round and 28.0 feet of blast hole per foot of advance. These figures might appear high for the normal 4' x 6' subdrift sections but possibly close observation will find them in agreement with actual mine practices.

The anomaly in holes drilled per foot of subdrift in the "A" method is understandable when one considers that the labour factors in this method were also quite different from other methods. If much more stoping is to be done with

the A mining method it would be well to investigate the work and reporting methods for development work in this type of stoping.

(ii) <u>Holes Drilled per Ton of Ore Broken vs Stope Classification</u> - Figures 56 - 59

The results here are fairly regular and the A method is comparable to the other classification. Use factors in the narrow widths show some gaps but these can be expected as narrow widths are seldom found in C type stopes. It appears that 0.3 holes drilled and blasted per ton broken is normal for ore in 4' - 6' widths.

The 6' - 10' width gives a continuous curve with an average drilling factor of about 0.18 holes per ton. If one had a measure of the length of holes drilled it is possible some of the fluctuations would be removed.

In wide breaking ores only the major mining methods are represented. Factors of 0.13 and 0.10 holes per ton broken would be reasonable estimates for breaking in 10' - 20' and +20' widths.

(2) <u>Pounds of Explosive Reported per Production Unit vs Stope Class</u>

In general the overall aspect of these plots is one of fluctuation. If, however, one disregards the B Fay class, some measure of stability is apparent.

(i) Pounds of Explosive Reported per Foot of Stope Development vs Stope Classification Figures 60 - 63

Distance from the mill hole should have no effect on explosive usage. Examination of the plotted estimates show that no consistent difference is present. Ignoring B Fay class we see that 13 lbs. of explosive per foot of subdrift is a reasonable estimate for explosive use in development. This agrees very well with the drilling factor, as the normal load of Amex in 1-1/4" diameter holes is 0.5 lbs. per foot.

(ii) Pounds of Explosive Reported per Ton of Ore Broken vs Stope Classification - Figures 64 - 66

The B type of stoping still shows anomalous results. Ignoring these estimates it appears that 0.8, 0.6 and 0.5 are reasonably good estimates of powder use in widths of 6' - 10', 10' - 20' and +20'. These values also are in good agreement with drilling factors when the normal 10' blast hole is assumed for rock breaking.

GENERAL DISCUSSION OF RESULTS

Examination of the estimates, both from overall and from classified correction factor regression analyses of stope contract data, demonstrates that reasonable and usable costs and contract rates can be obtained from these contract records.

Of the various classifications, it appears that the time series classification gives the most useful results. The mining method classification could be quite useful in detailed investigations of particular work methods. The incentive rate classification has little analytical value except perhaps to demonstrate one aspect of rate equity.

The factors calculated with the regressions of expendable materials could be invaluable in production control. The use of this method in evaluating the results of testing programs on new materials and methods will certainly give much better information for decision than the normal raw average methods.

The regression program (12) with its available transformations has been a very useful tool in this analysis. It does, however, have one major failing. A number of the production units in the data were, under some regression models, equivalent. All subdrifting, for instance, in the materials regressions could have been considered together as one variable rather than four. Multiple regression with these variables added together may have, in this case, returned much better results. This type of additive transformation capability would make this regression program much more general in many analytical problems.

When gathering data one is often uncertain as to the best types and categories of measurements to make. With an additive transformation capability in a regression program one can make a wide spectrum of classes and categories of measurements with the assurance that combination of like classes is possible on analysis.

Throughout the preceeding analysis no mention has been made of possible extensions of the regression equation into polynomial or logarithmic terms. Logarithmic terms of both the dependent and independent variables were tested extensively. Computer outputs of these programs are on file (23, 24) but the analysis is not presented in detail in this thesis. It appeared that the model $Y = \sum B_j X_j + \sum G_j \log X_j$ improved prediction of contract hours by one to two percent over the simple linear model but the added difficulty in interpretation of the results far outweighed the added accuracy.

A second factor which is also concerned with extensions on the model is that of interactions. With thirty-two linear independent variables it would be surprising if some of the possible thirty-two factorial interactions were not significant. Thorough investigation of interaction factors could be part of a full systems analysis of mine stope production but would have only confused this analysis of a relatively simple contract system.

Correlation, a statistical technique which normally accompanies the use of regression, has been absent throughout this work. The reason for this exclusion was dictated by the nature of the data.

Correlation is defined only for random variables. If one speaks of the statistical correlation of subdrifting and ore breaking, as measured from contract records, then one implies that the amount of subdrifting and the amount of ore breaking, done in a stope in a contract period is mainly governed by random causes. This assumption immediately negates such governing factors as production and standard practices which certainly are operative and non-random in the real situation. Mine contract systems, the central concern of this thesis, are operated and administered under real conditions. For this reason the simple correlations which the computer program (12) calculates for all regression, a sample of which is given in Appendix 2, pages 2 to 5, were not applied in the analysis.

The final but by no means minor topic of discussion is one of economics. The following estimate of the operating costs of a monthly regression analysis of stope contract records has been derived from the author's experience with contract records and computer systems gained in this work.

The gathering of the data in a form acceptable to computer analysis could, for very little cost, be incorporated in the normal mine accounting system. If this system were machine-computation orientated the required data should be a byproduct of contract calculations. Computer time for analysis of a program will be between 5 to 10 minutes for a large machine such as the IBM 7040 and possibly 20 to 40 minutes for a smaller machine such as the IBM 1130. The preparation of the results from the computer should, on a regular

basis, occupy a clerk no more than one to two hours. The costs for the above should be no greater than $20.00 per computation plus possibly $20.00 allocated to clerical workers. If one compares this estimate with the probable costs of time study staff that would be required to produce similar results, the economic advantages of multiple regression are immediately apparent.

CONCLUSIONS

The use of multiple regression as an analytical and control tool for mine contract administration has been demonstrated. The application of this tool by a competent and interested staff can provide precise, economic and timely information to mine management. This information is the basis upon which all good administration is founded. One must not, however, conclude that this or other statistical techniques are a replacement for time and method study or the seasoned judgement of contract administrators. Statistical methods are tools which, when applied properly, will allow the contract staff to make much more efficient use of their particular capabilities.

The techniques developed in this thesis need not be restricted to underground mining. Contract systems based on time study and related methods of evaluating the labour content of production are common throughout industry. Past records for payment of these contracts should also be available. With multiple regression using the Correction Factor approach, these records can be analysed to provide an independent and unbiased evaluation of most contract systems. I feel that this type of evaluation would be an invaluable tool with which to construct better systems, for all concerned with contracts.

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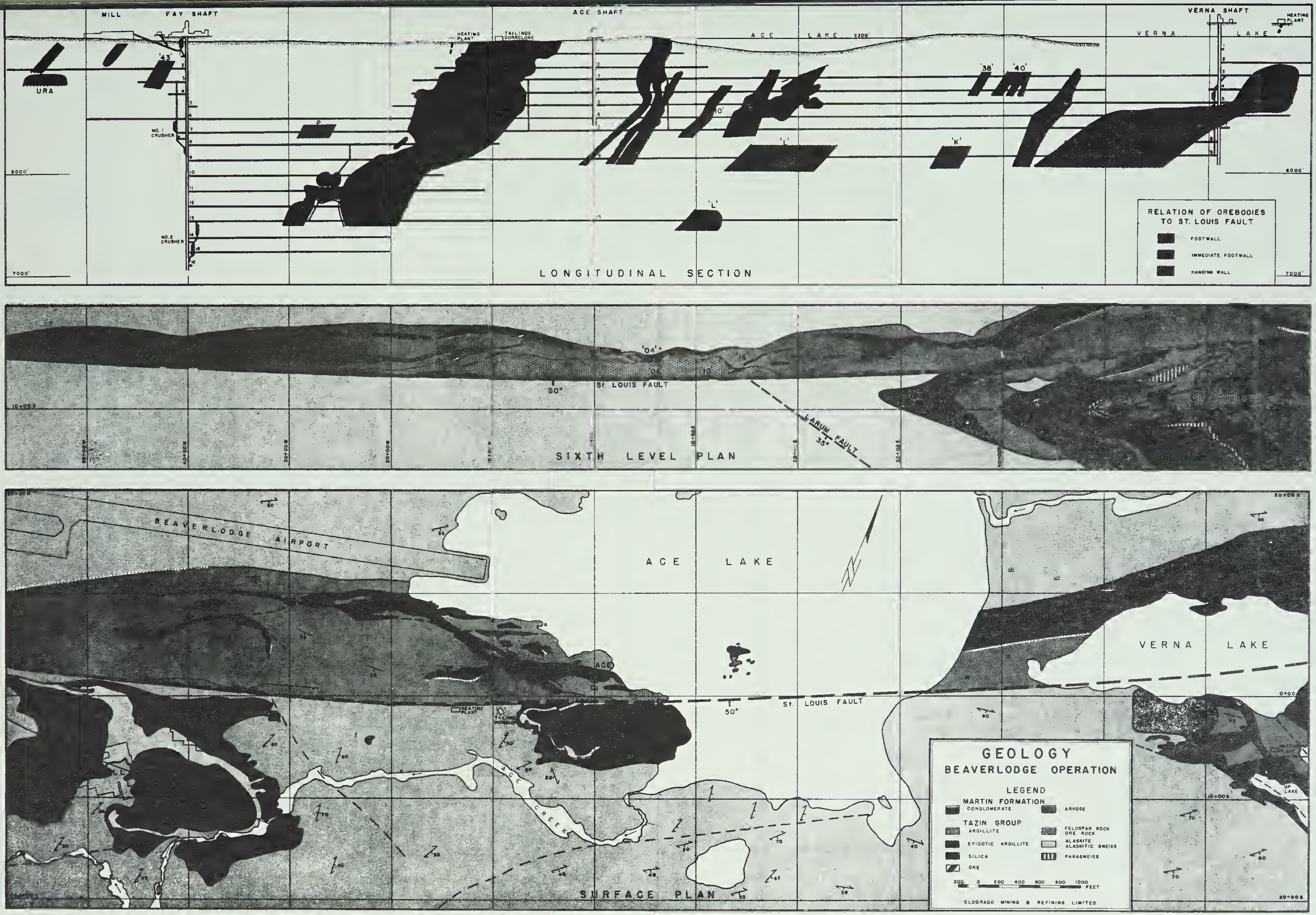

Fig. 1 LONGITUDINAL SECTION AND SURFACE GEOLOGY
ELDORADO MINING & REFINING BEAVERLODGE OPERATION
(from Can. Min. Journal, June, 1960)

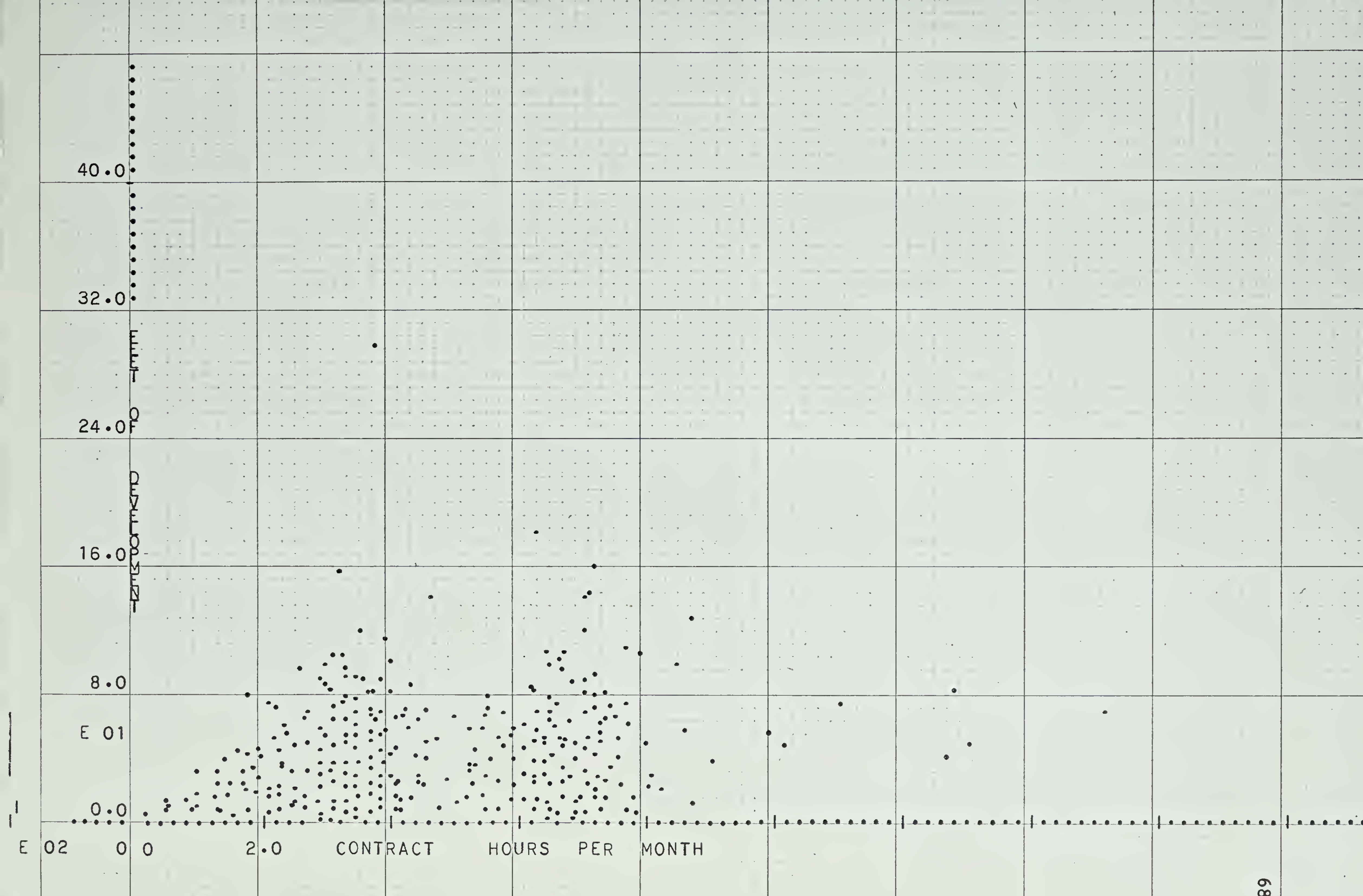

FIG. 2 - FEET OF DEVELOPMENT VS CONTRACT HOURS PER MONTH

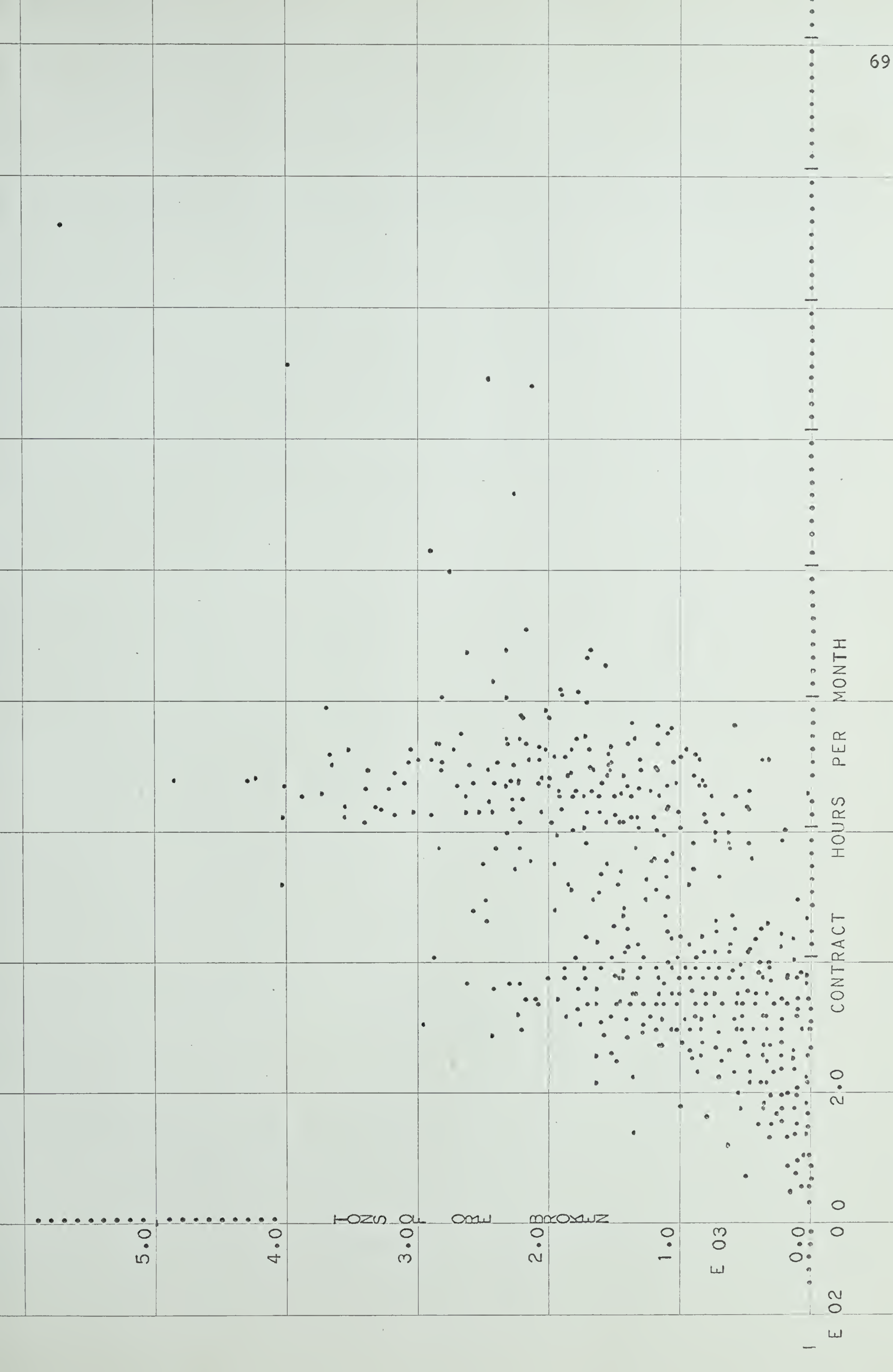

FIG. 3 - TONS OF ORE BROKEN VS CONTRACT HOURS PER MONTH

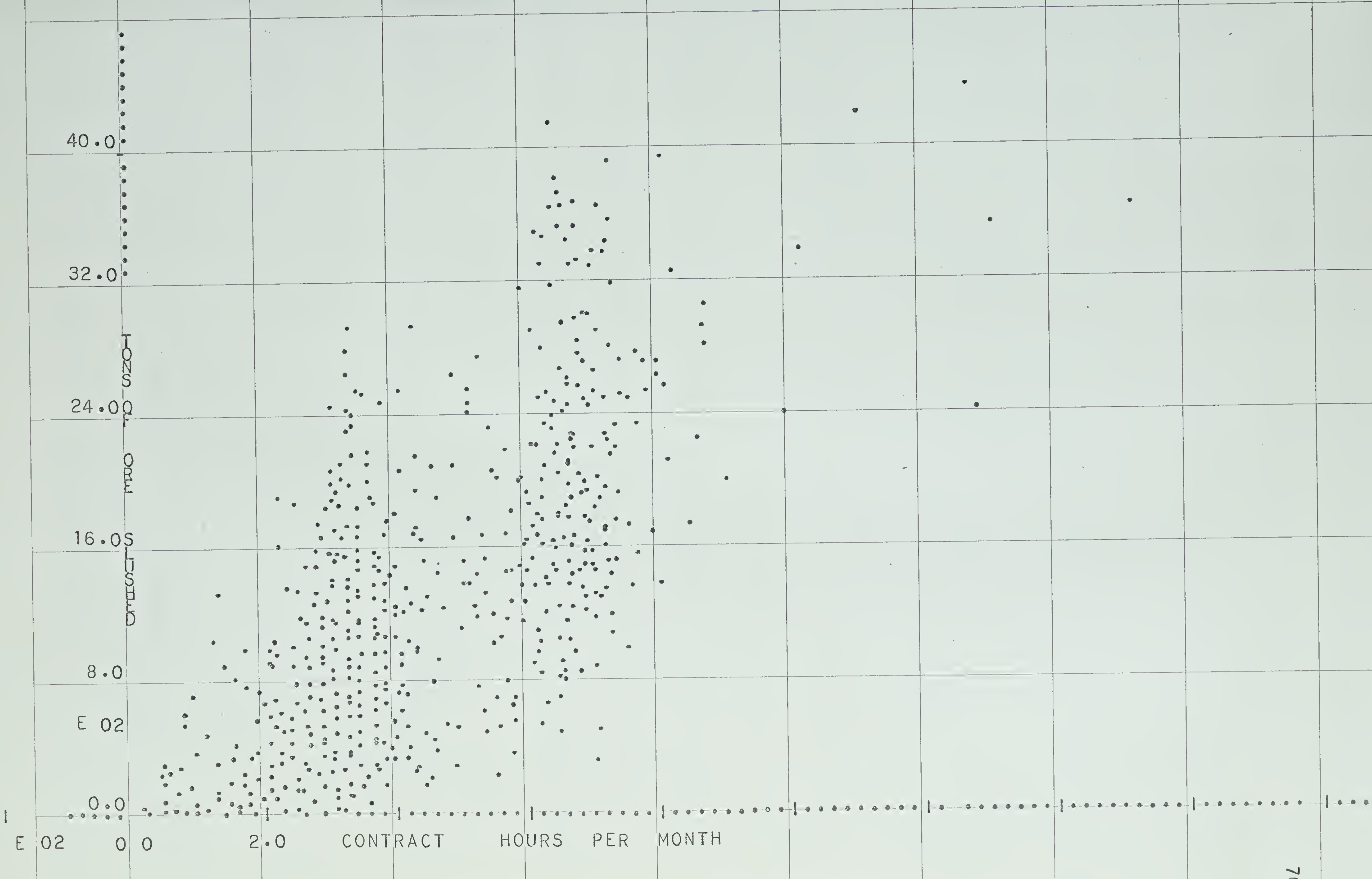

FIG. 4 - TONS OF ORE SLUSHED VS CONTRACT HOURS PER MONTH

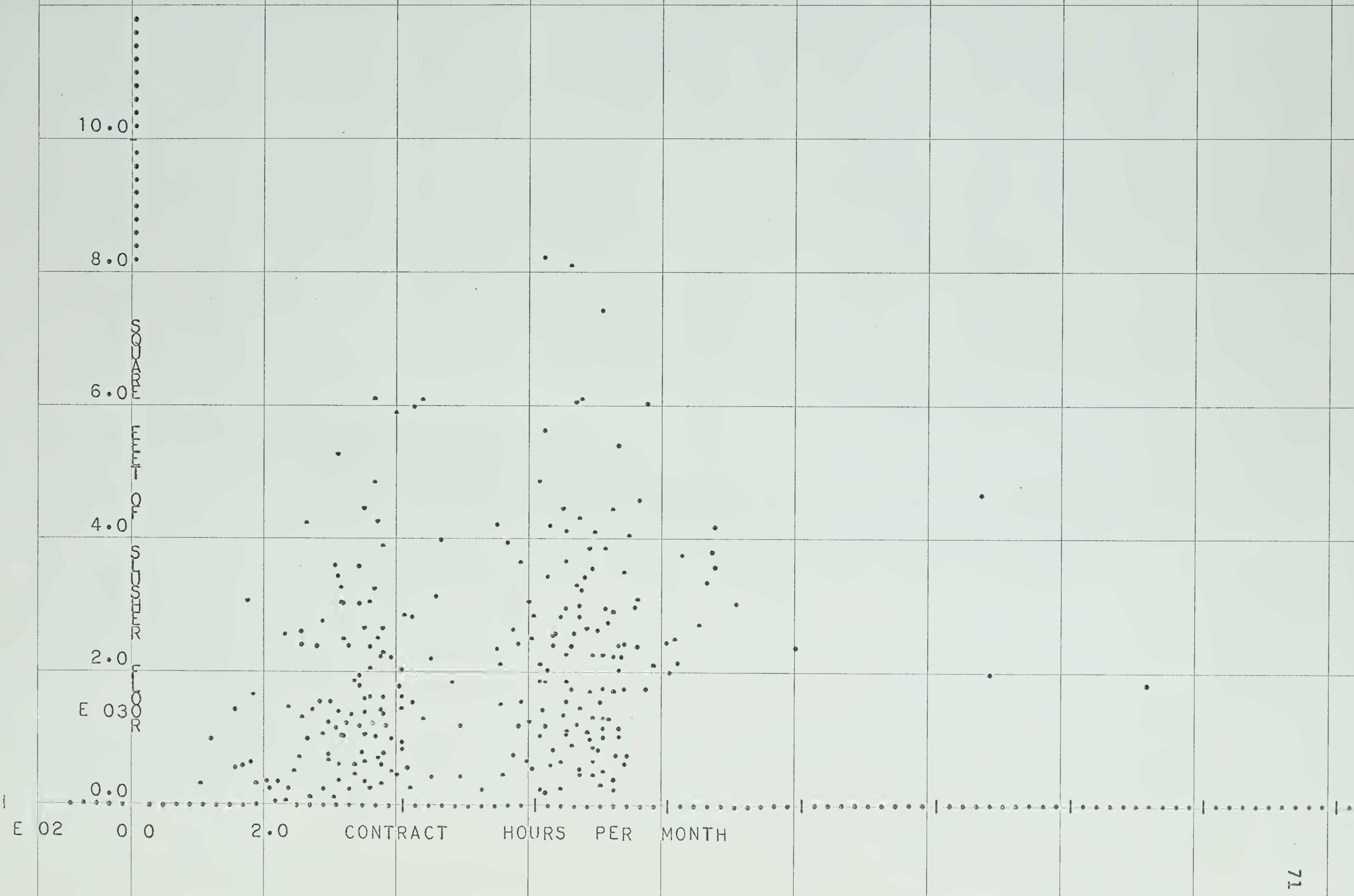

FIG. 5 - SQUARE FEET OF SLUSHER FLOOR VS CONTRACT HOURS PER MONTH

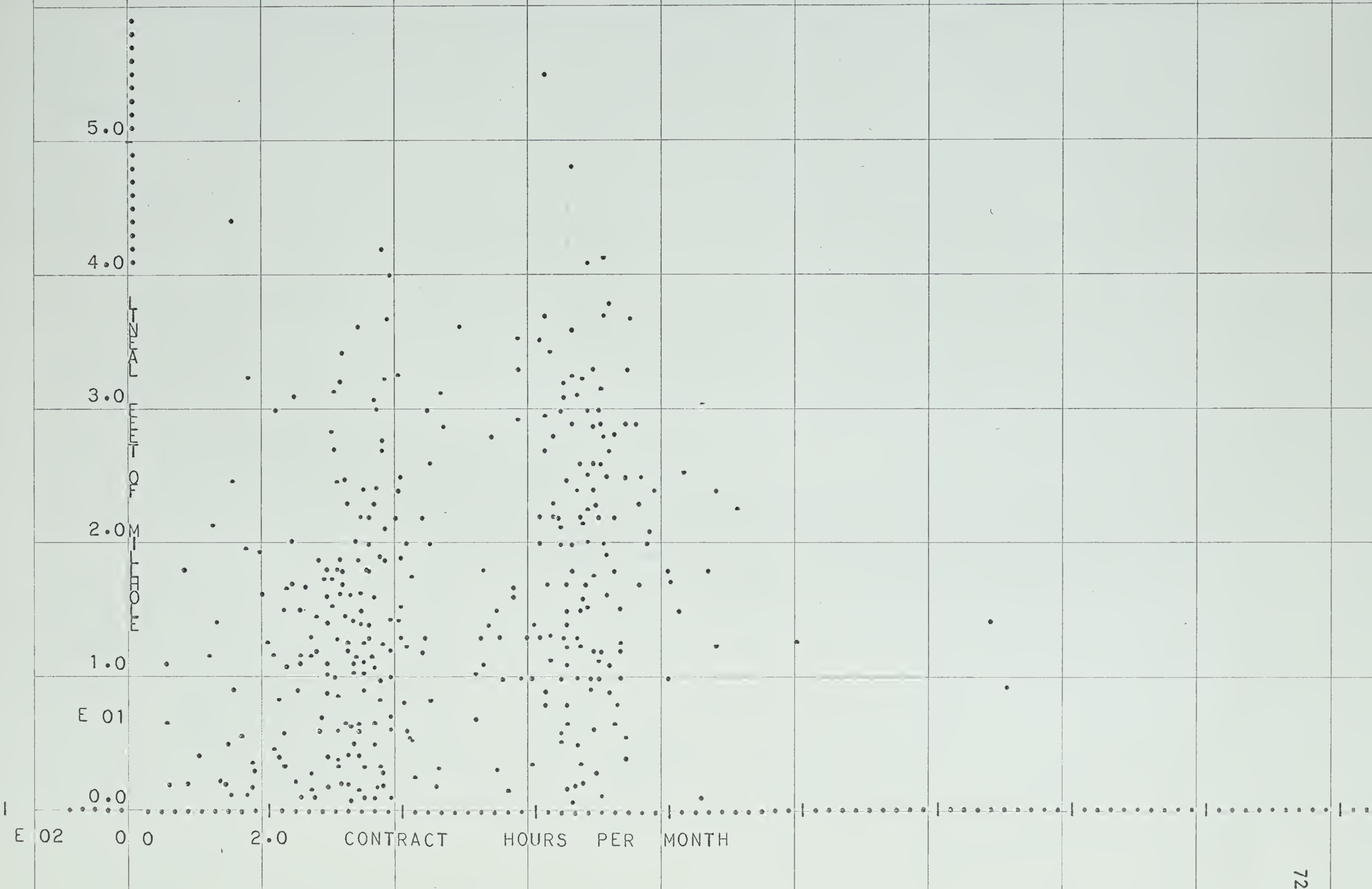

FIG. 6 - LINEAL FEET OF MILLHOLE VS CONTRACT HOURS PER MONTH

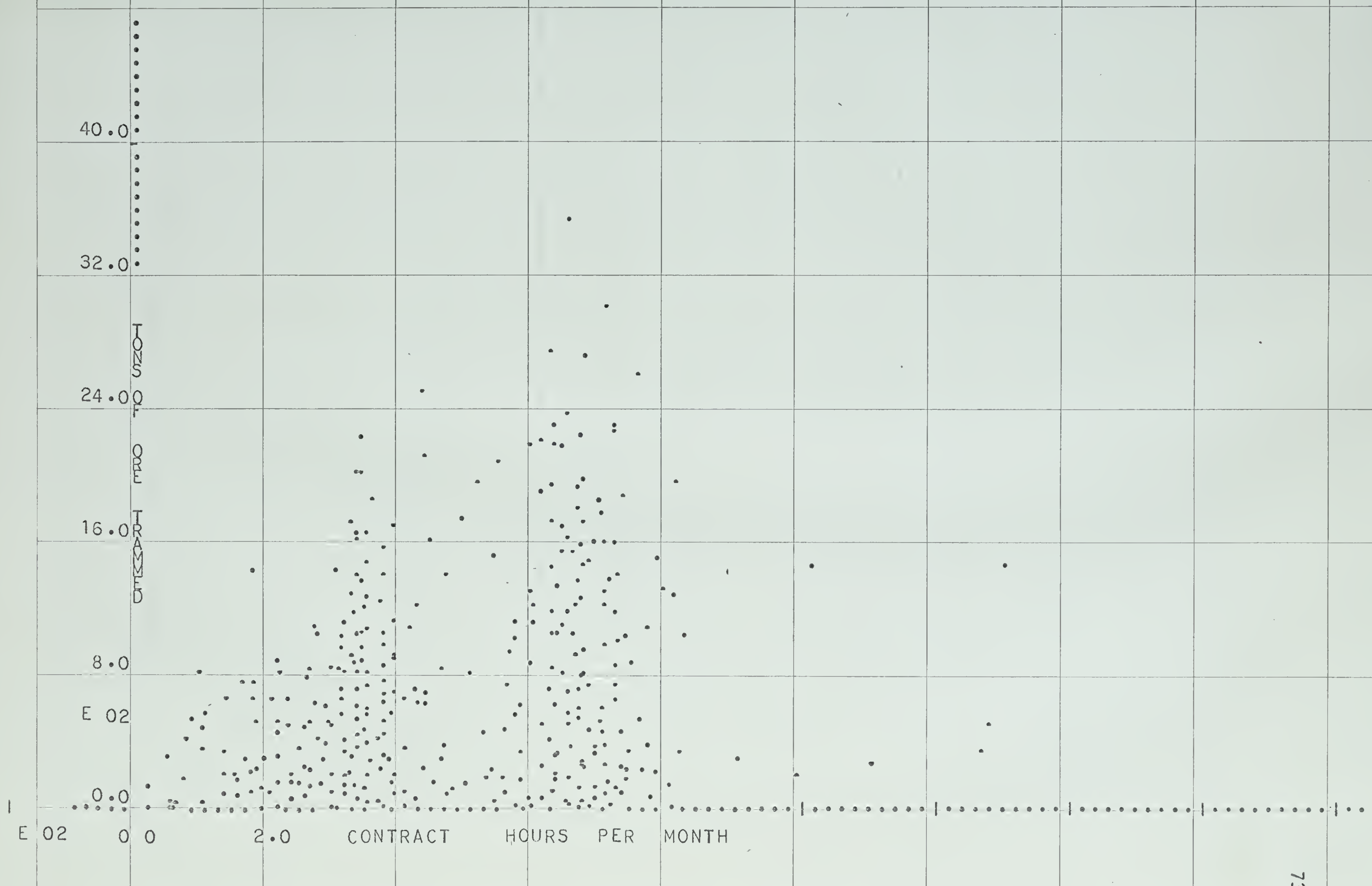

FIG. 7 - TONS OF ORE TRAMMED VS CONTRACT HOURS PER MONTH

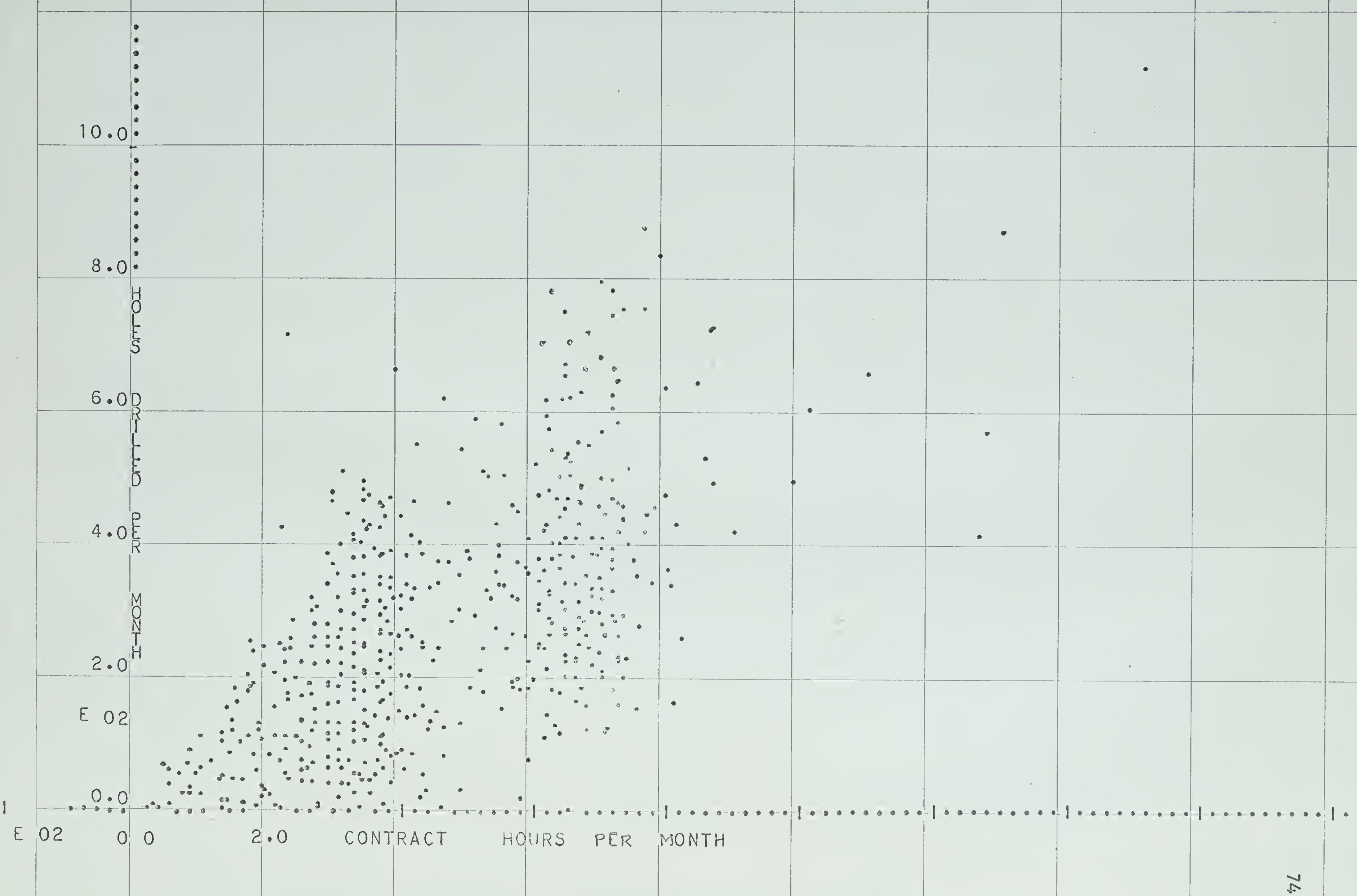

FIG. 8 - HOLES DRILLED PER MONTH VS CONTRACT HOURS PER MONTH

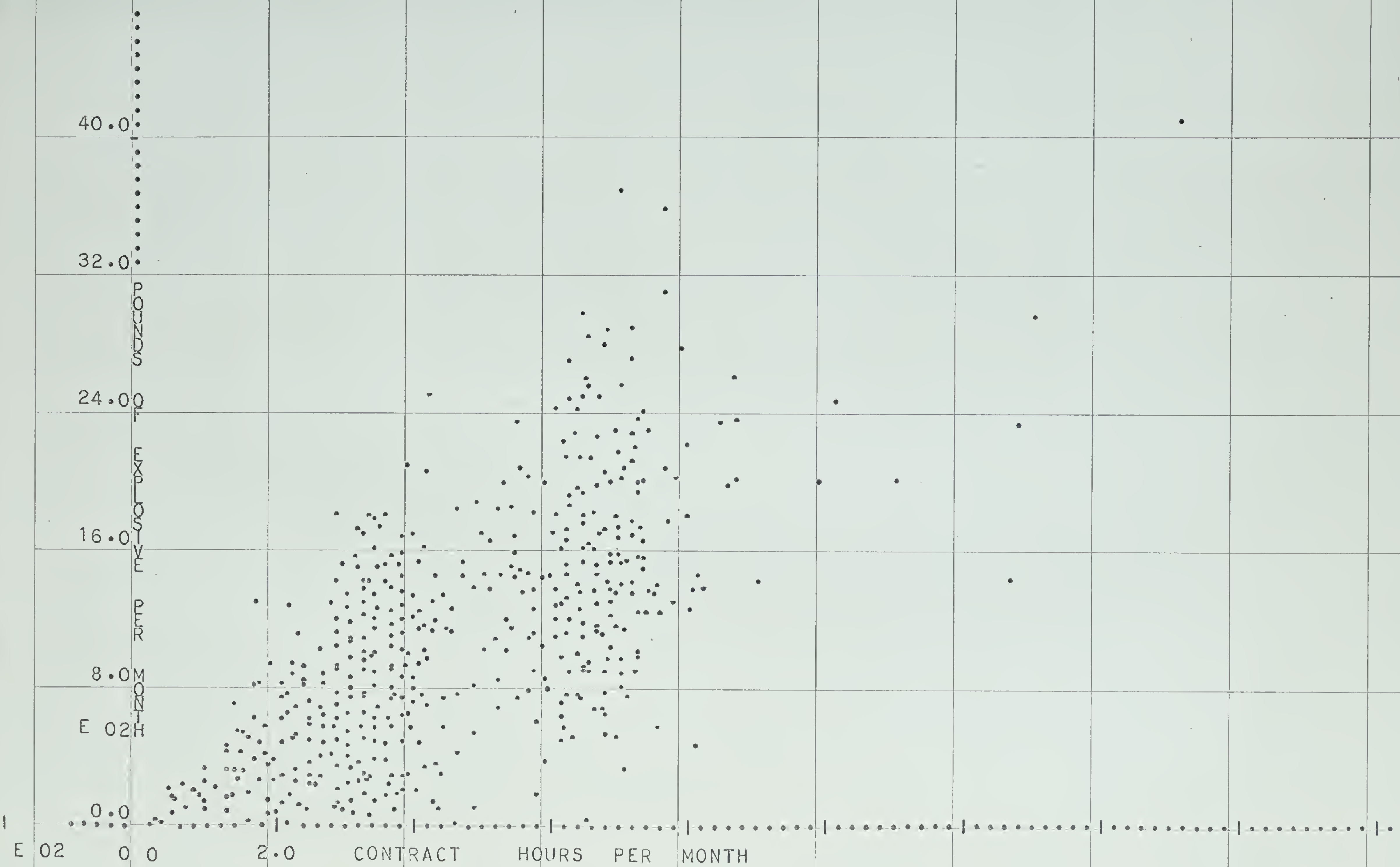

FIG. 9 - POUNDS OF EXPLOSIVE VS CONTRACT HOURS PER MONTH

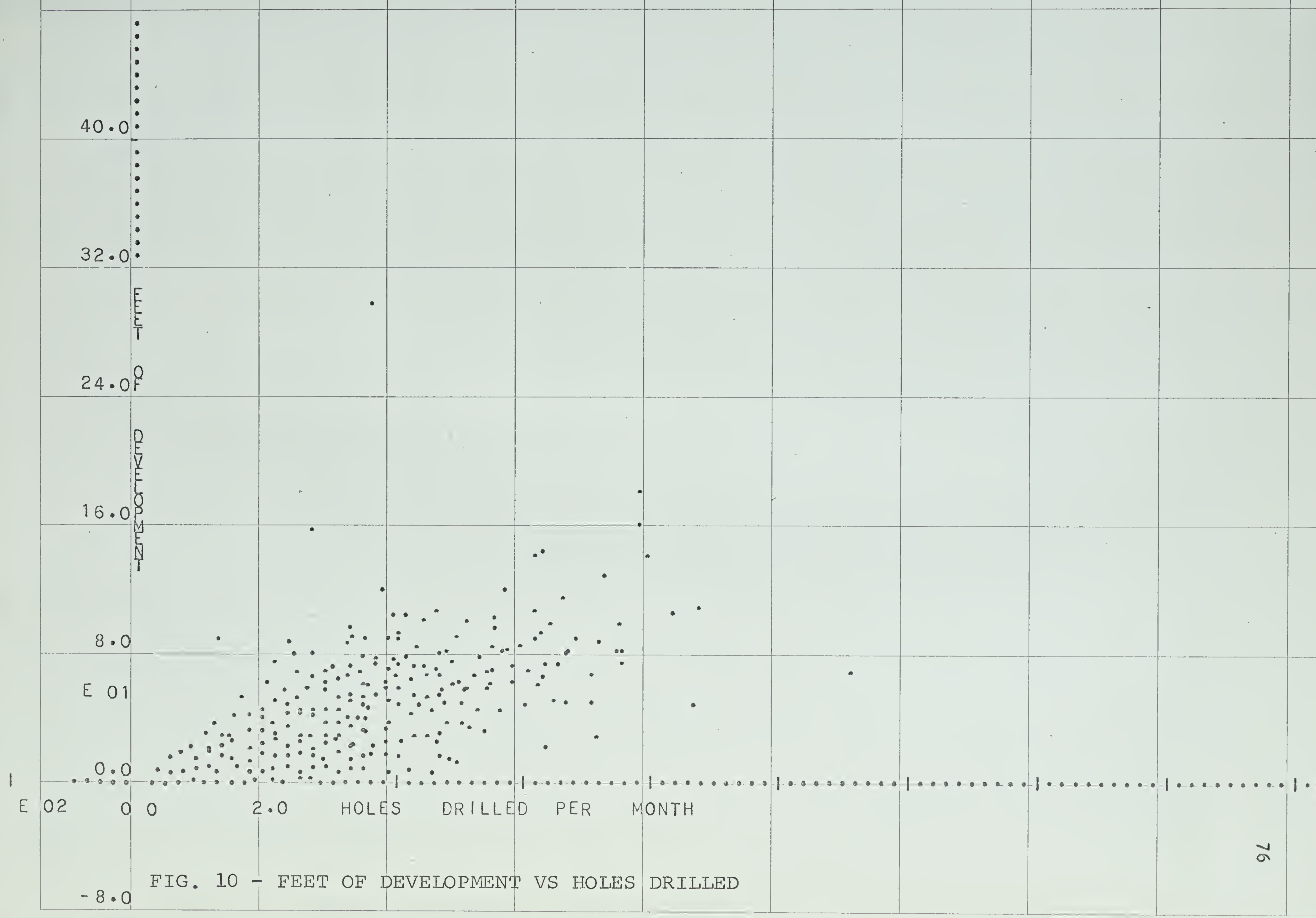

FIG. 10 - FEET OF DEVELOPMENT VS HOLES DRILLED

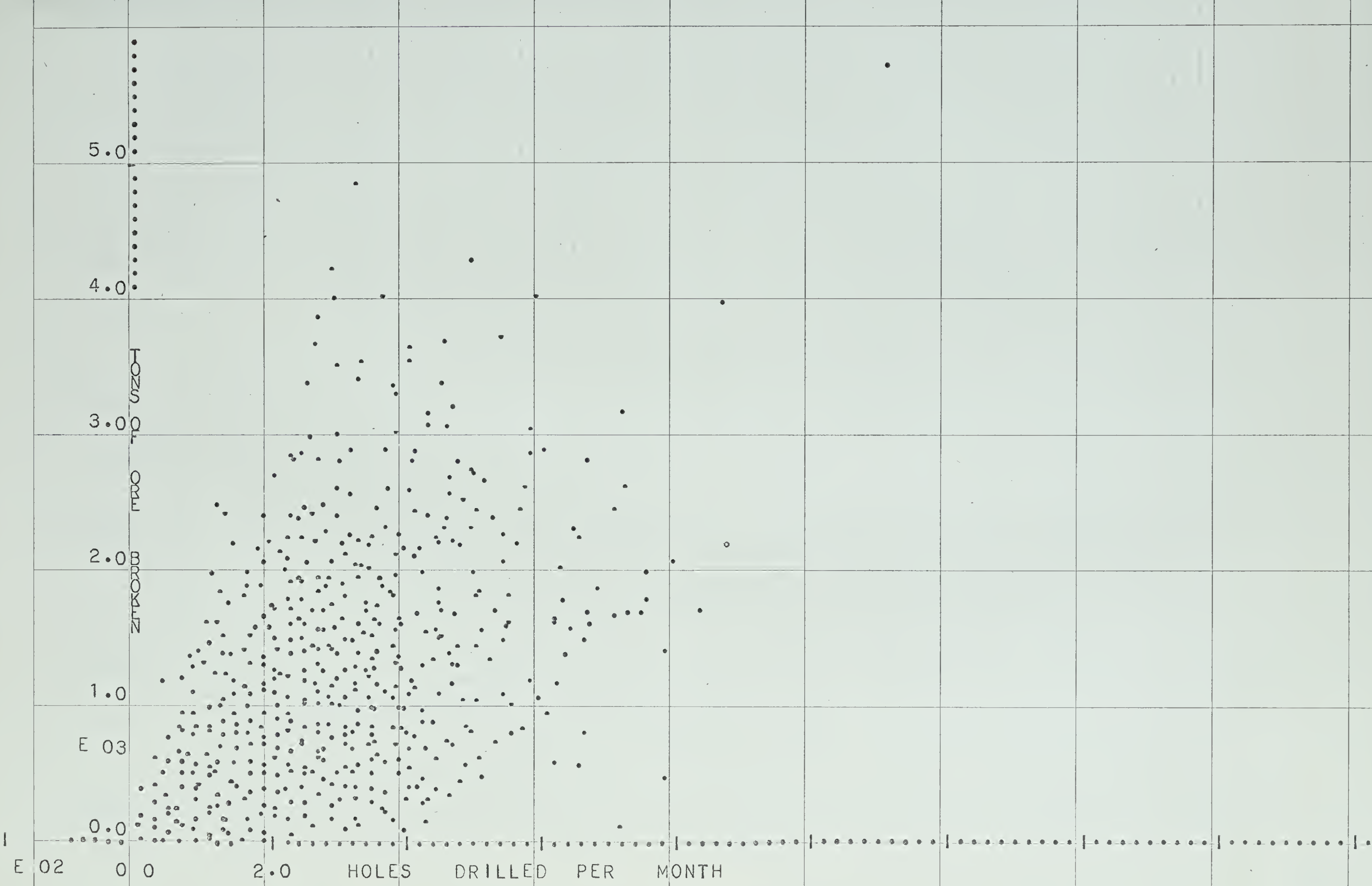

FIG. 11 - TONS OF ORE BROKEN VS HOLES DRILLED

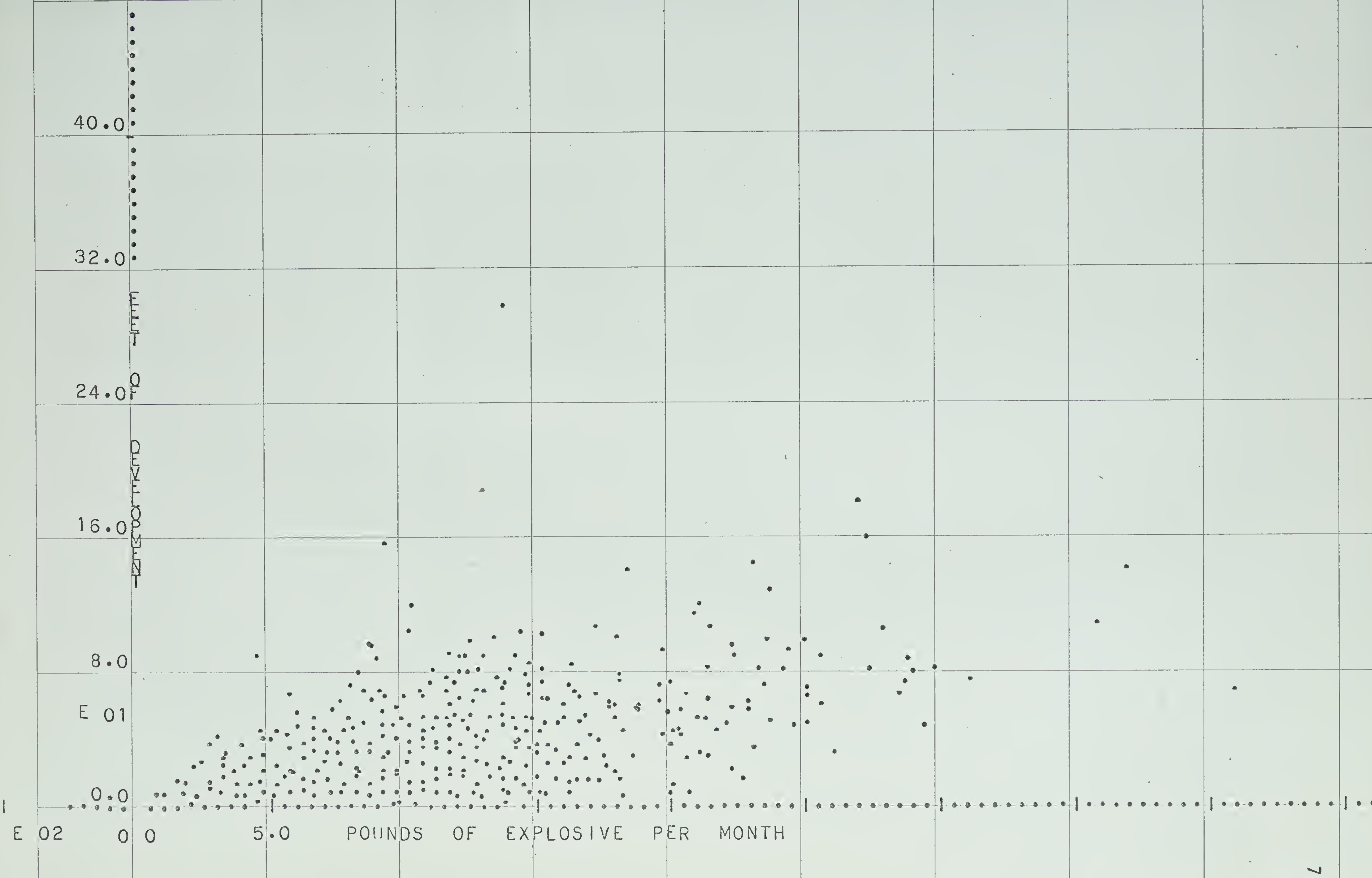

FIG. 12 - FEET OF DEVELOPMENT VS POUNDS OF EXPLOSIVE

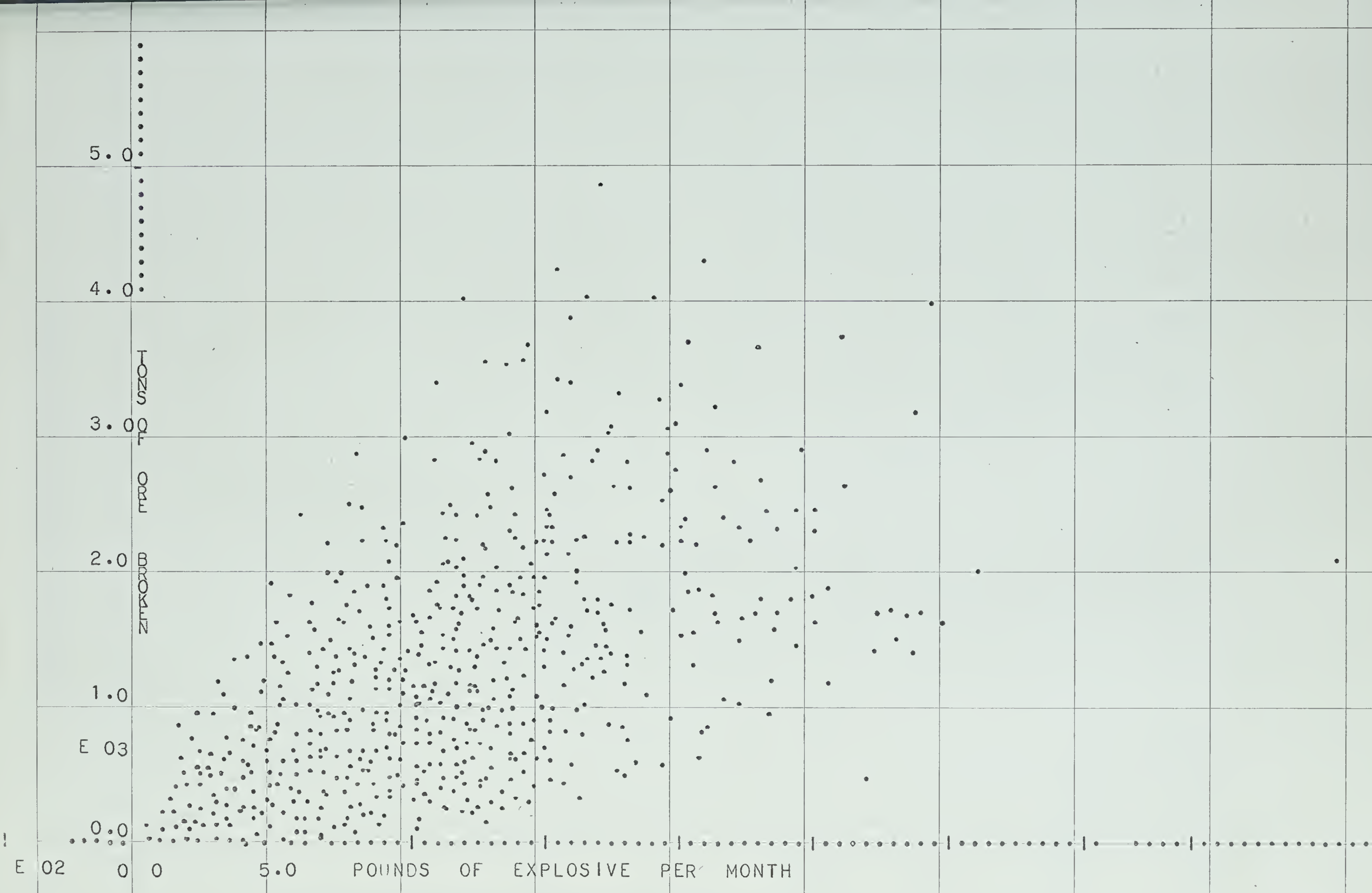

FIG. 13 - TONS OF ORE BROKEN VS POUNDS OF EXPLOSIVE

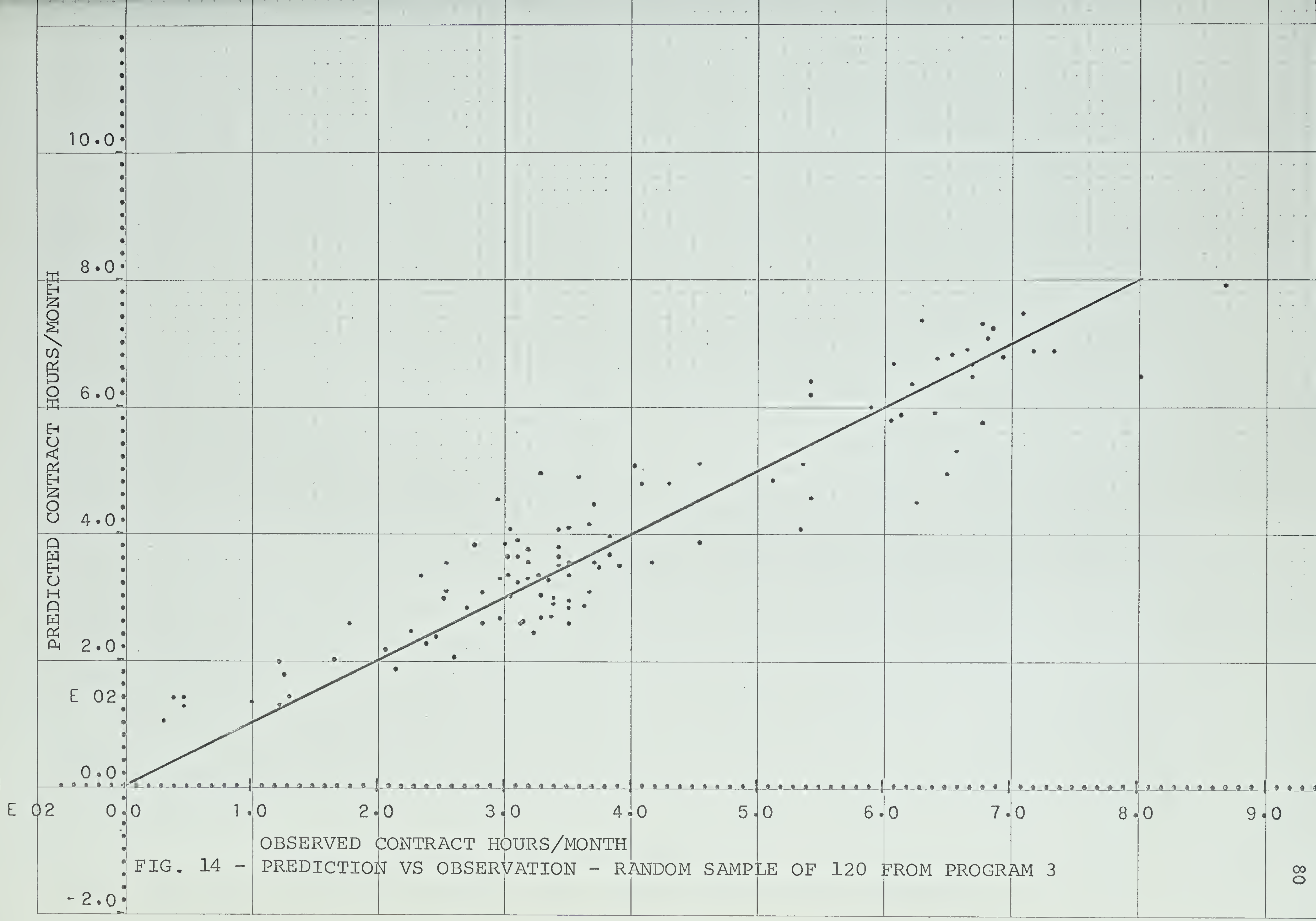

FIG. 14 - PREDICTION VS OBSERVATION - RANDOM SAMPLE OF 120 FROM PROGRAM 3

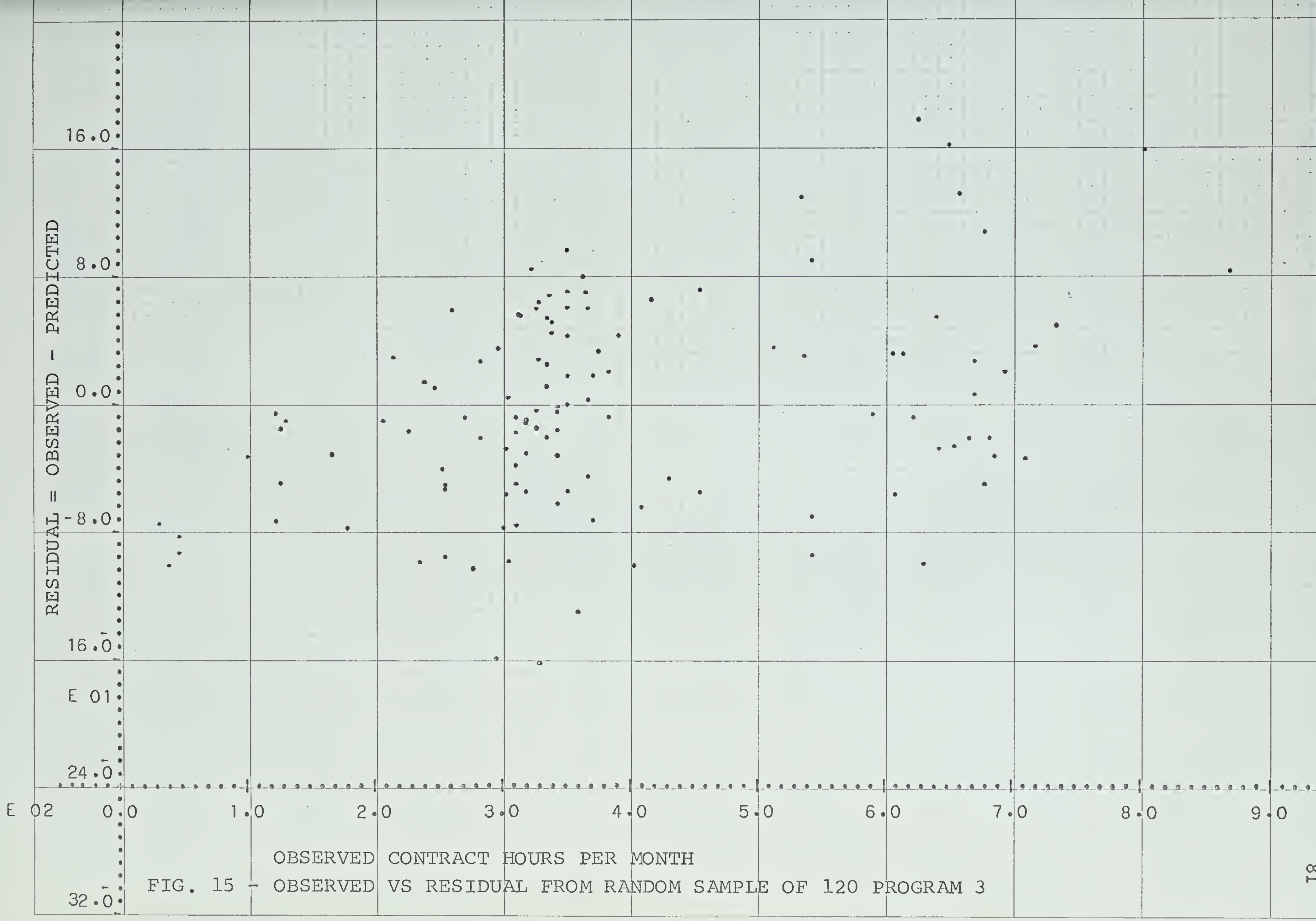

FIG. 15 - OBSERVED VS RESIDUAL FROM RANDOM SAMPLE OF 120 PROGRAM 3

FIG. 16 - MEAN BONUS VS TIME

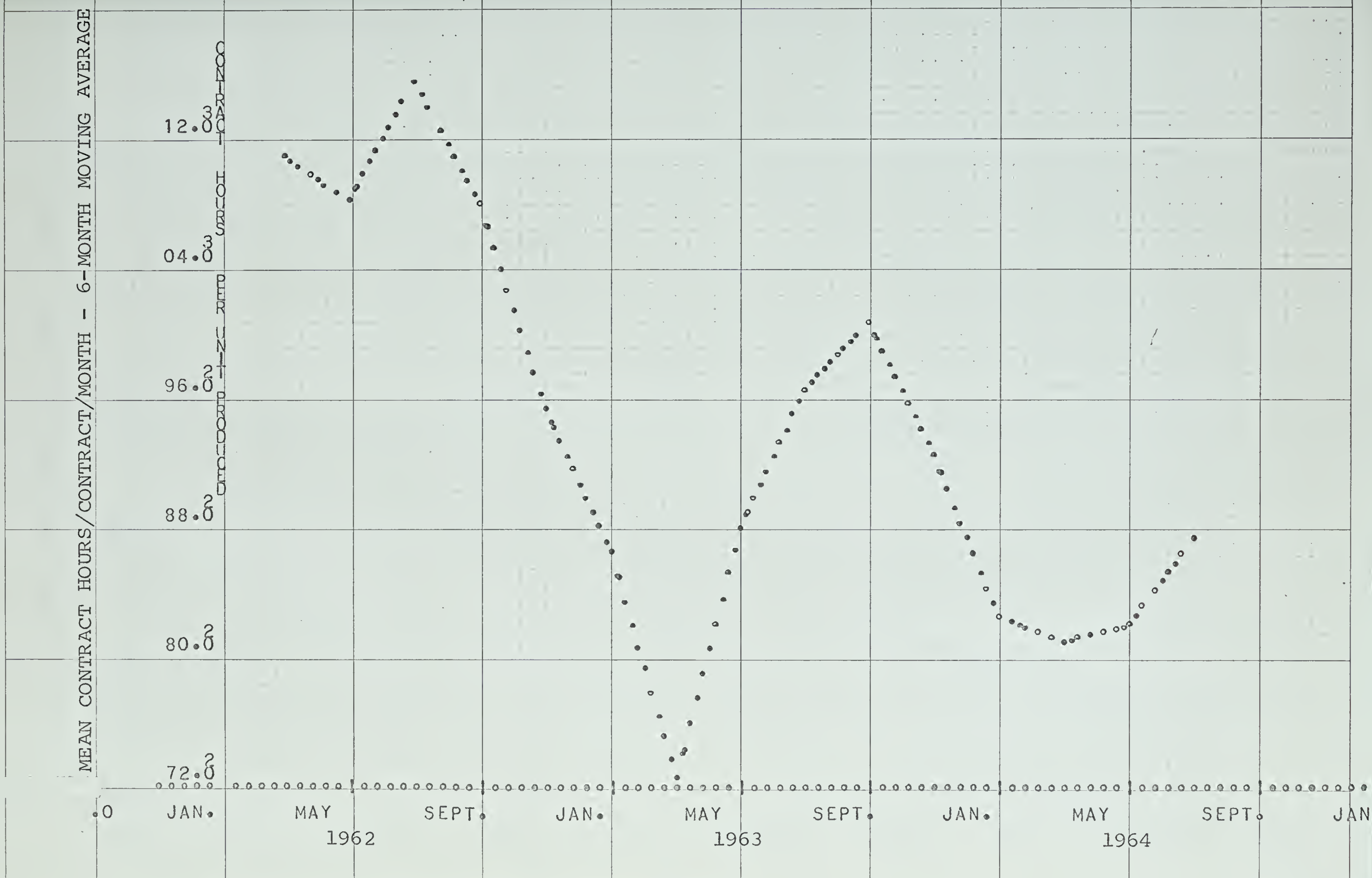

FIG. 17 - MEAN CONTRACT HOURS VS TIME

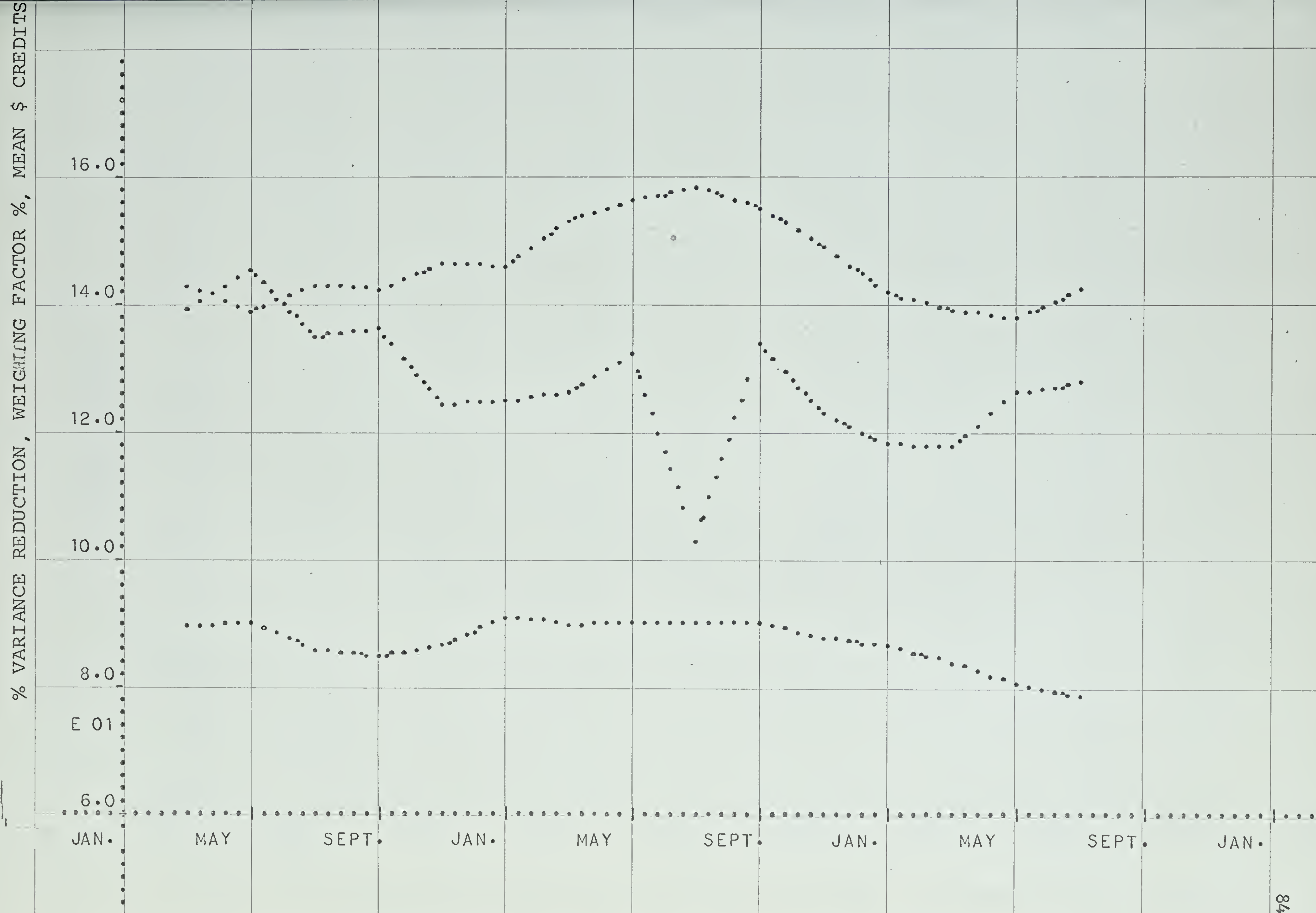

FIG. 18 - % VARIANCE REDUCTION, WEIGHTING FACTOR % $ MEAN $ CREDITS VS TIME
A 6 MONTH MOVING AVERAGE

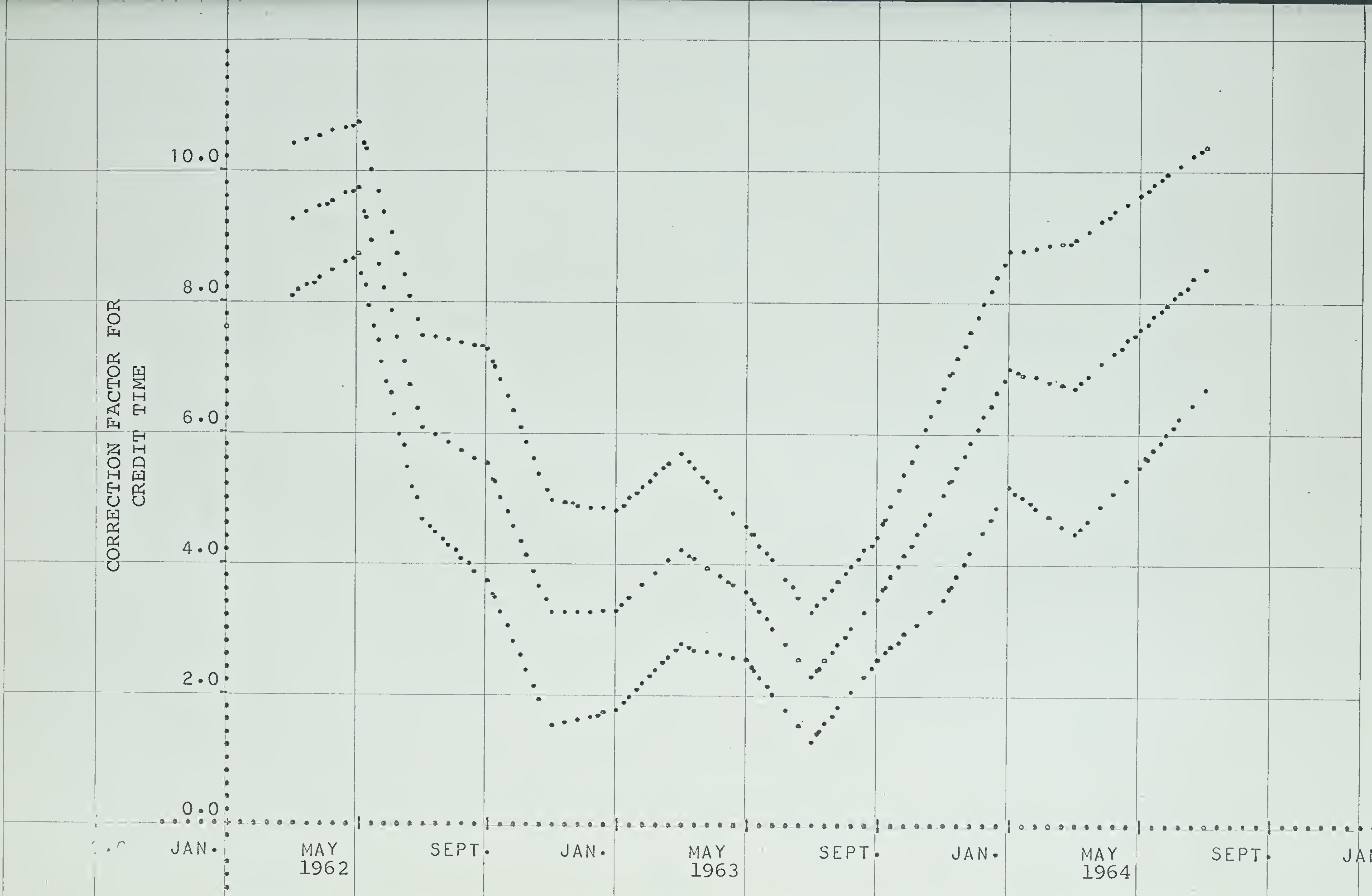

FIG. 19 - CORRECTION FACTOR FOR CREDIT TIME VS TIME - A 6 MONTH MOVING AVERAGE

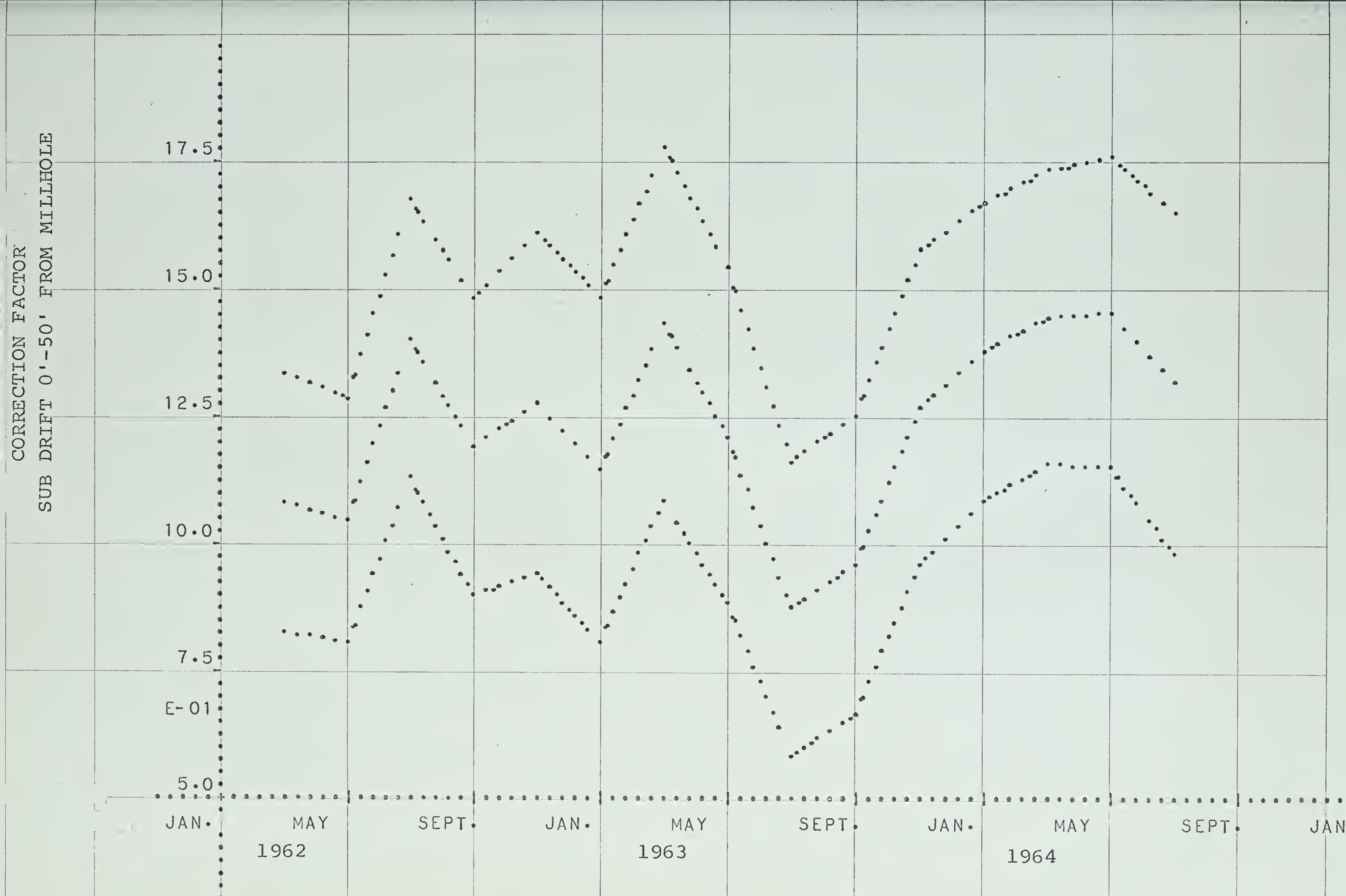

FIG. 20 CORRECTION FACTOR FOR SUB DRIFTING 0'-50' VS. TIME

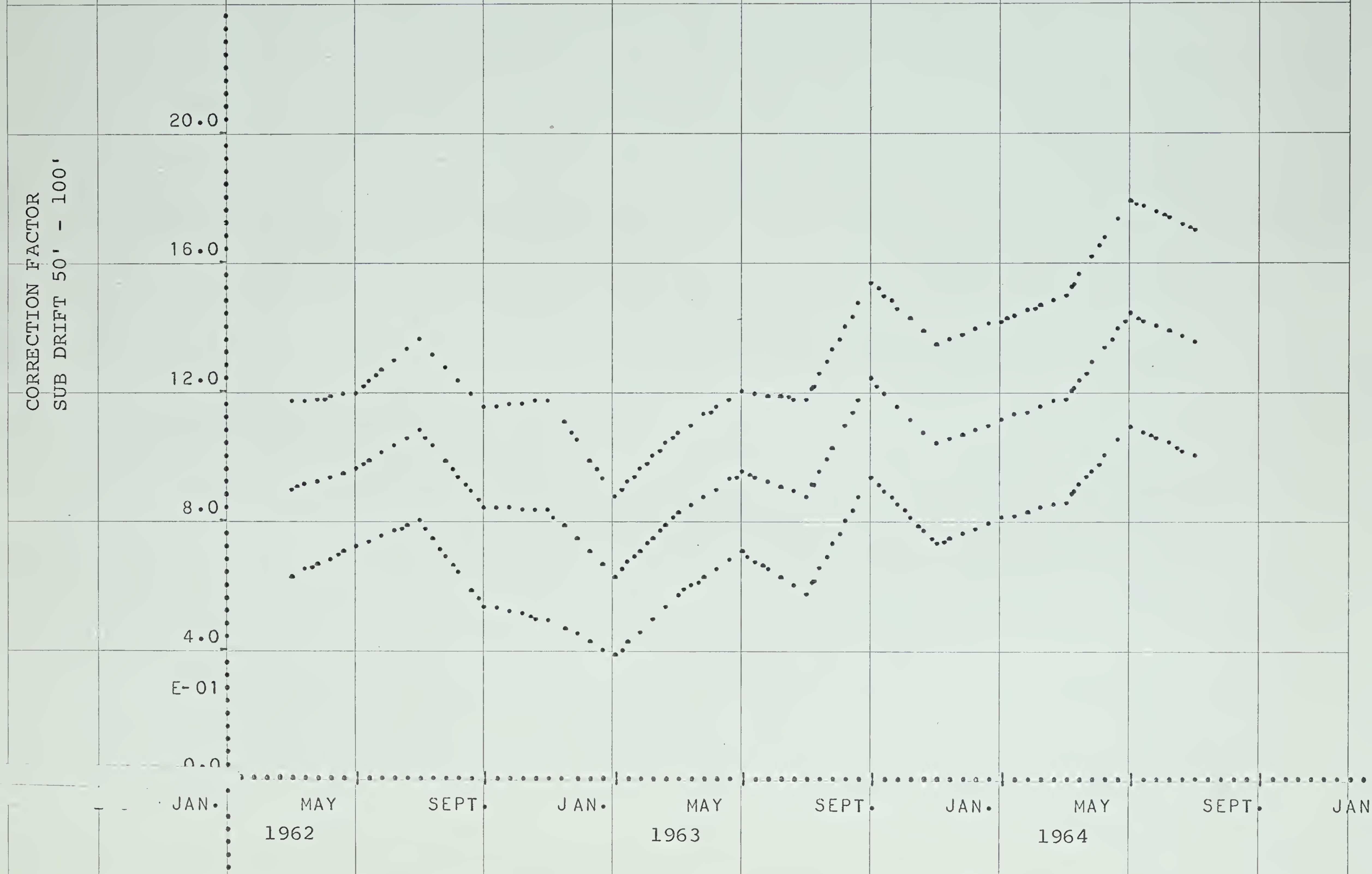

FIG. 21 - CORRECTION FACTOR FOR SUB DRIFTING 50'-100' VS. TIME

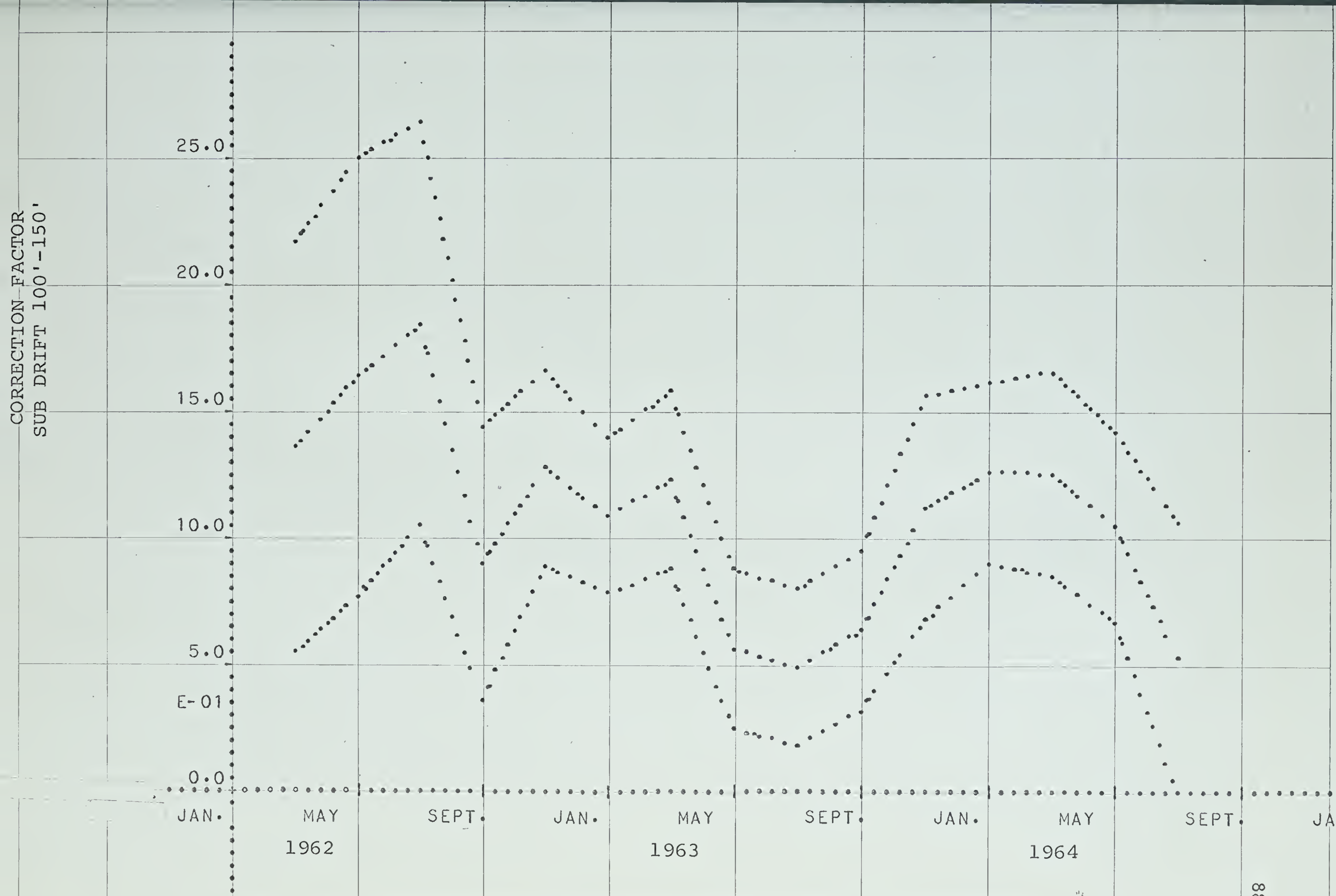

FIG. 22 - CORRECTION FACTOR FOR SUB DRIFTING 100'- 150' VS TIME

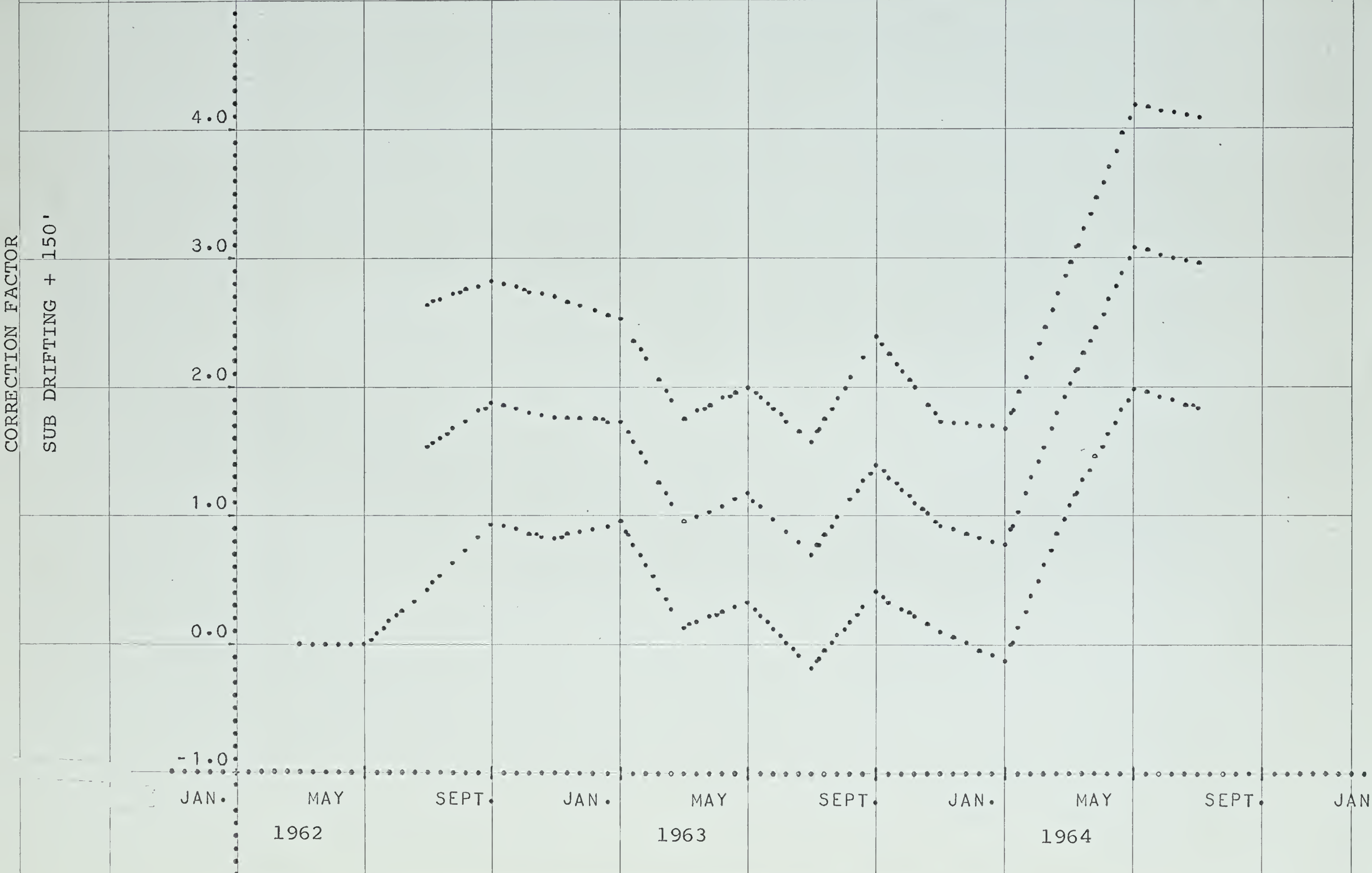

FIG. 23 - CORRECTION FACTOR FOR SUB DRIFTING + 150' VS TIME

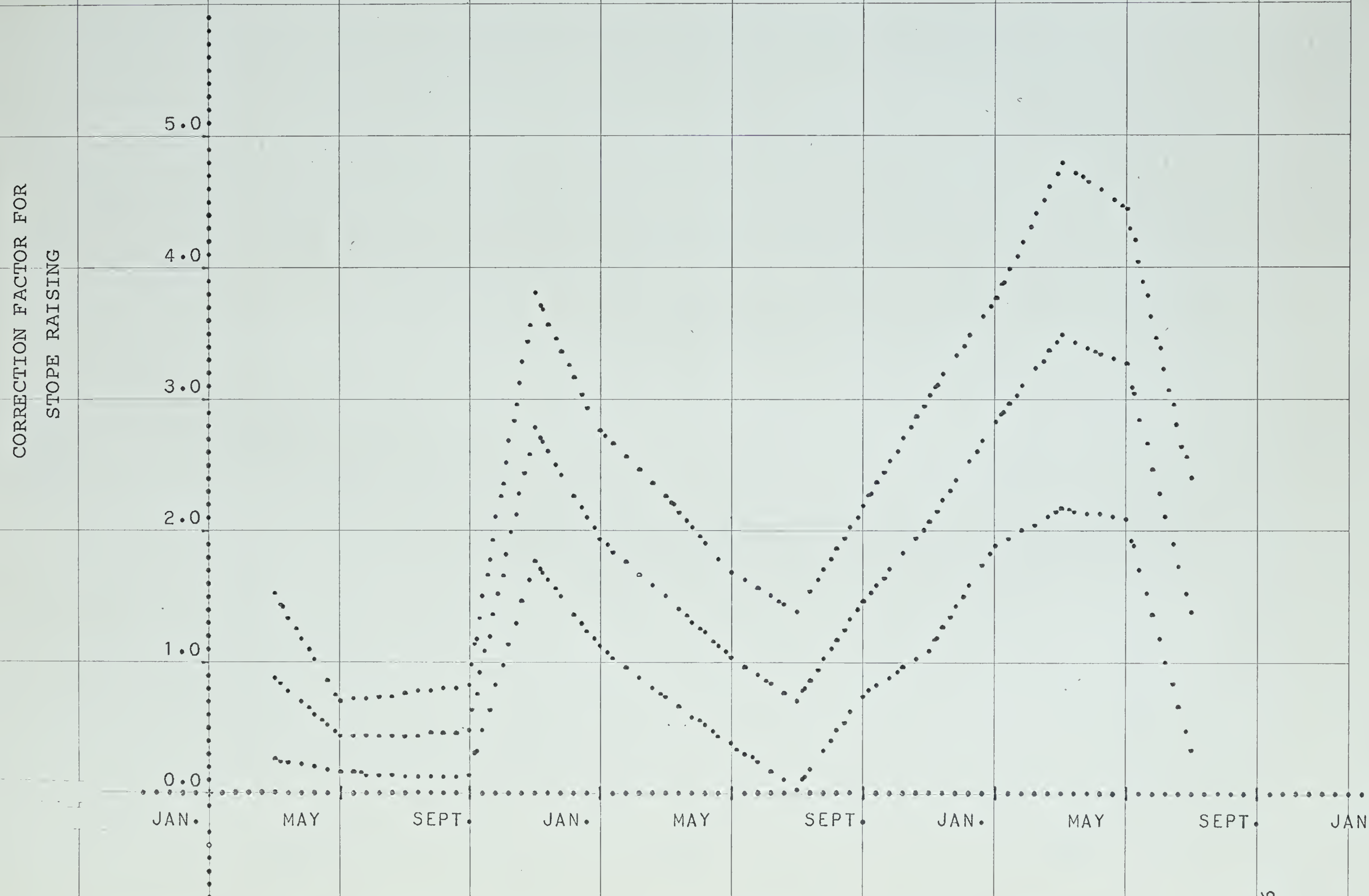

FIG. 24 - CORRECTION FACTOR FOR STOPE RAISING VS. TIME

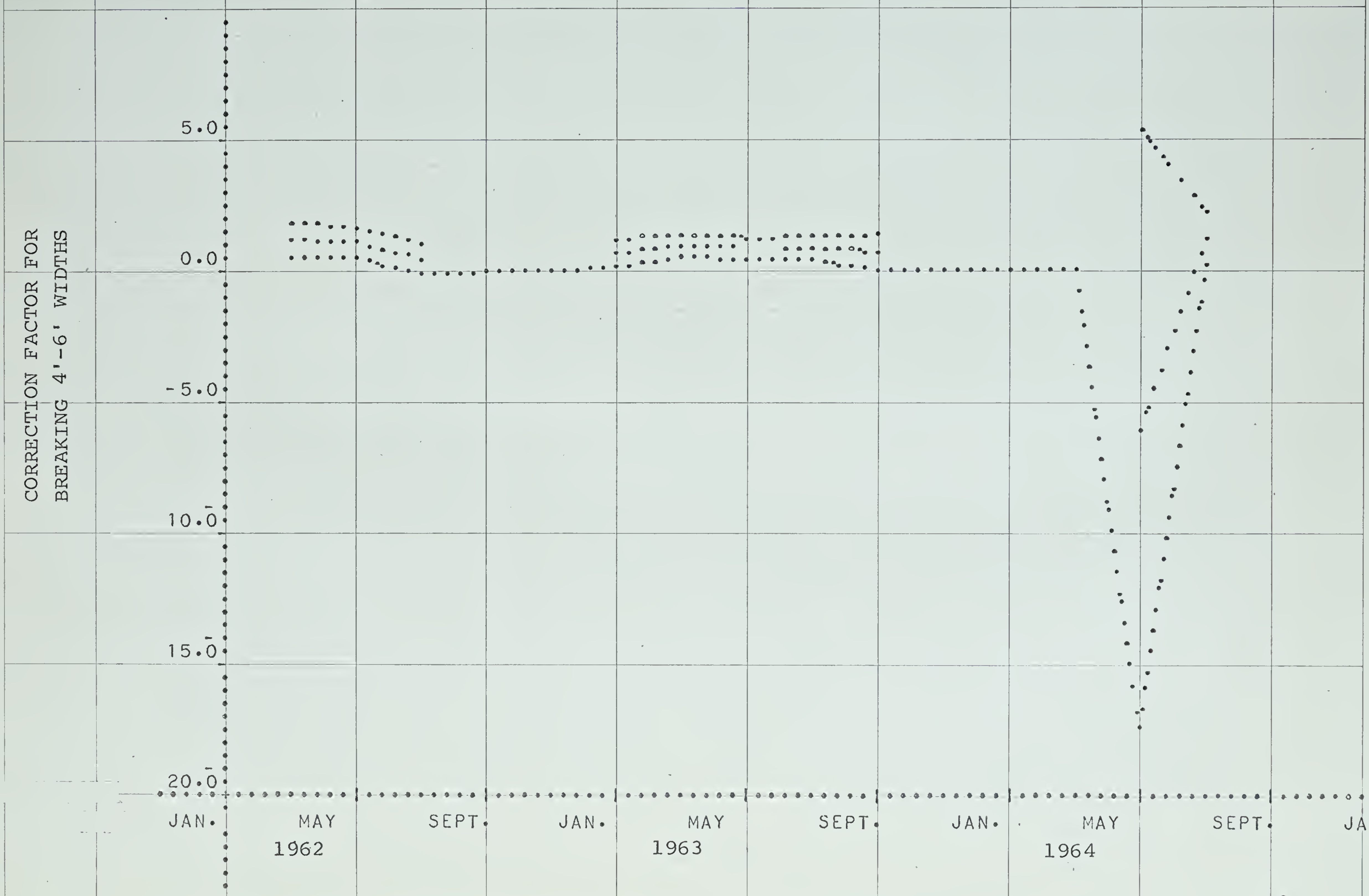

FIG. 25 - CORRECTION FACTOR FOR BREAKING 4'-6' WIDTHS VS. TIME

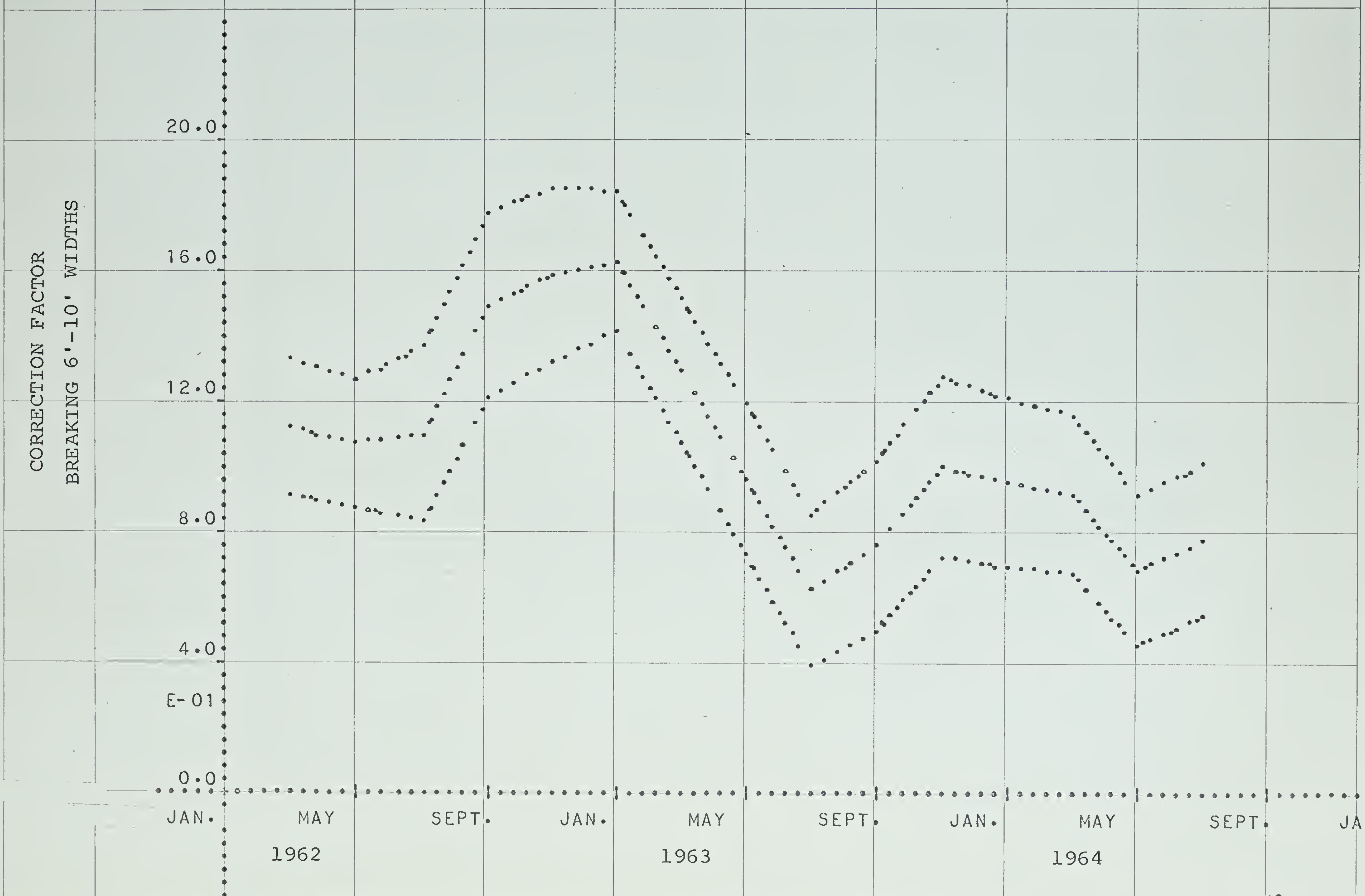

FIG. 26 - CORRECTION FACTOR FOR BREAKING 6'-10' WIDTHS VS. TIME

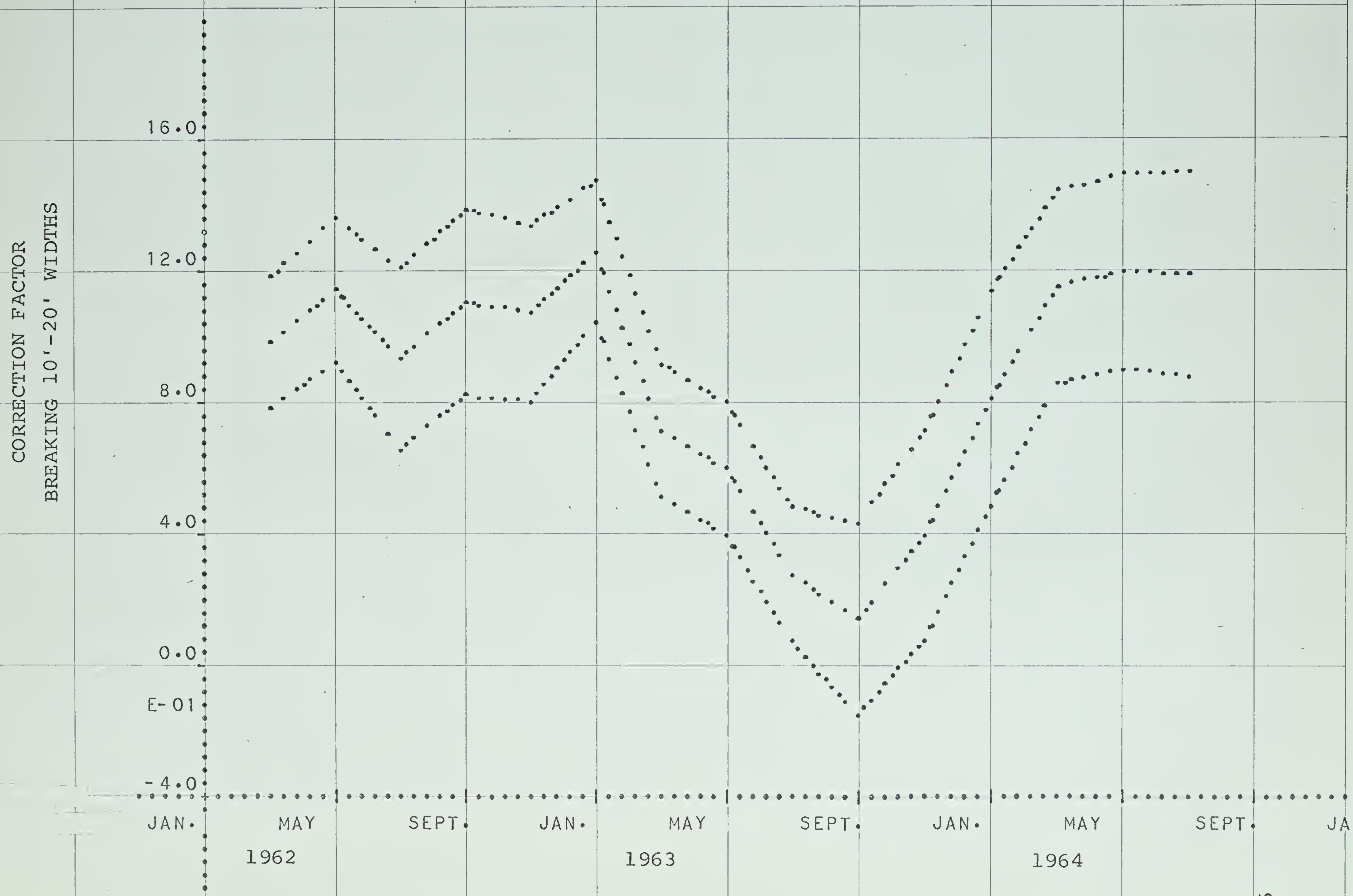

FIG. 27 - CORRECTION FACTOR FOR BREAKING 10'-20' WIDTHS VS TIME

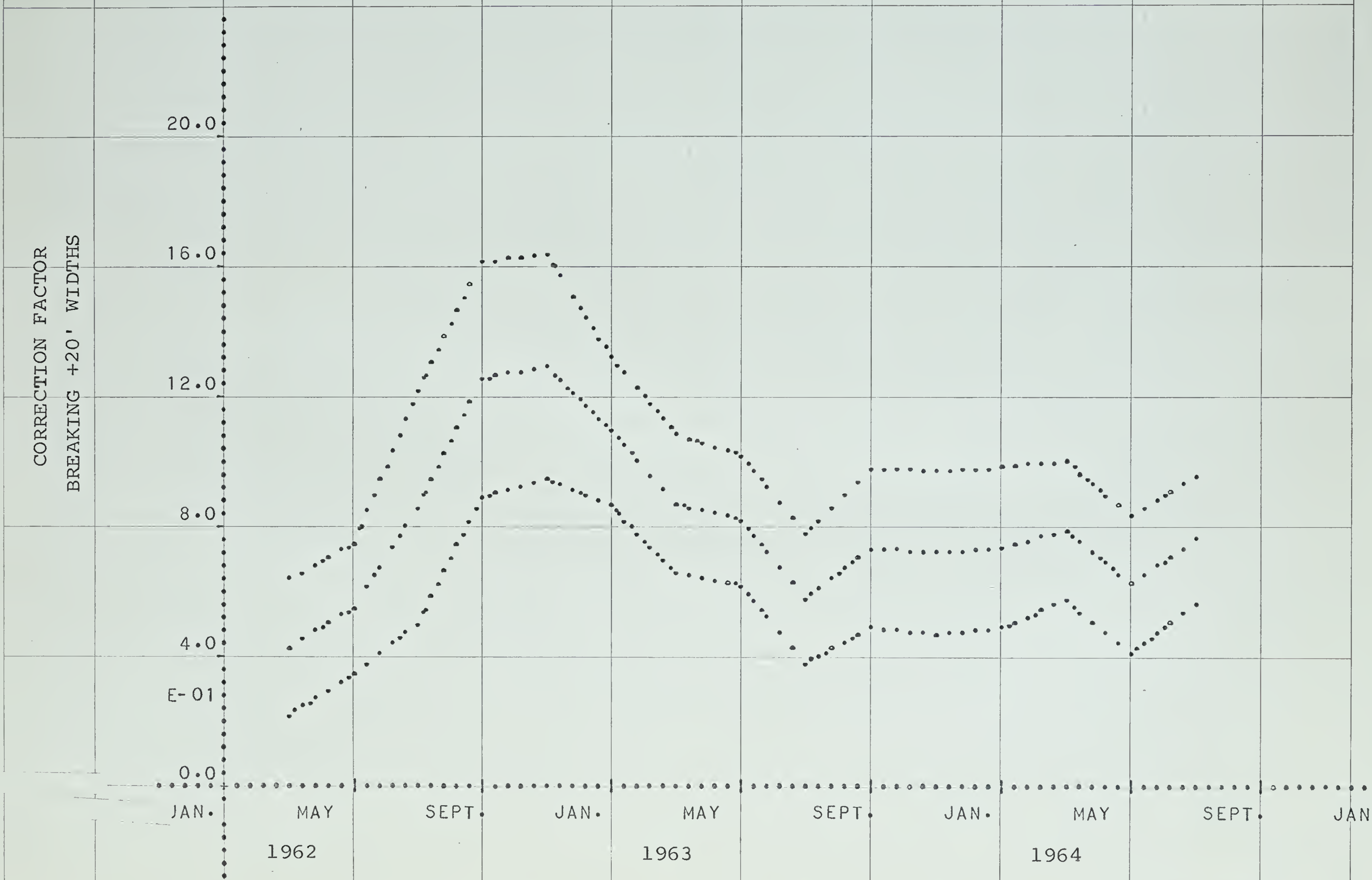

FIG. 28 - CORRECTION FACTOR FOR BREAKING + 20' WIDTHS VS. TIME

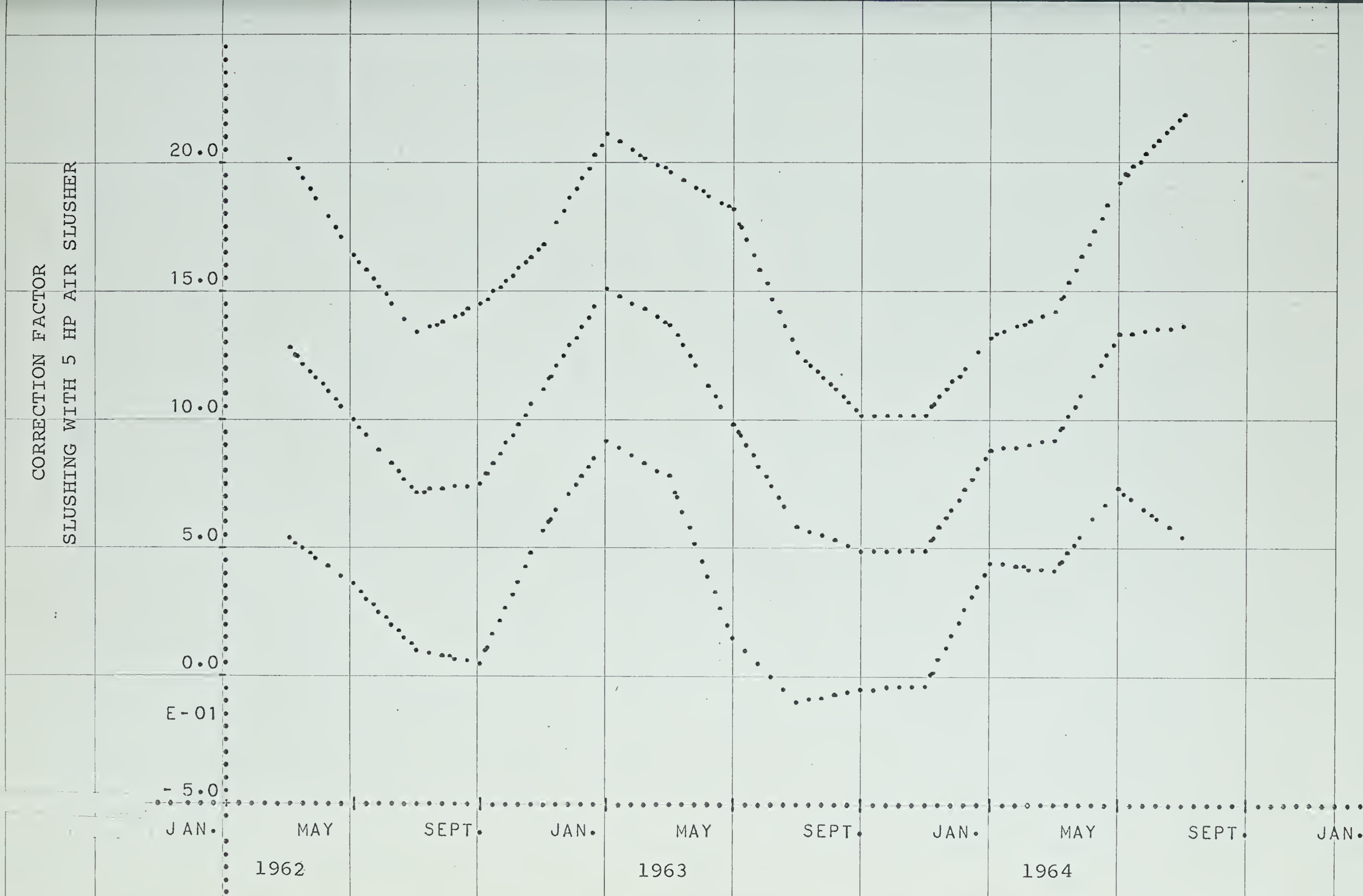

FIG. 29 CORRECTION FACTOR FOR SLUSHING WITH 5 HP AIR VS. TIME

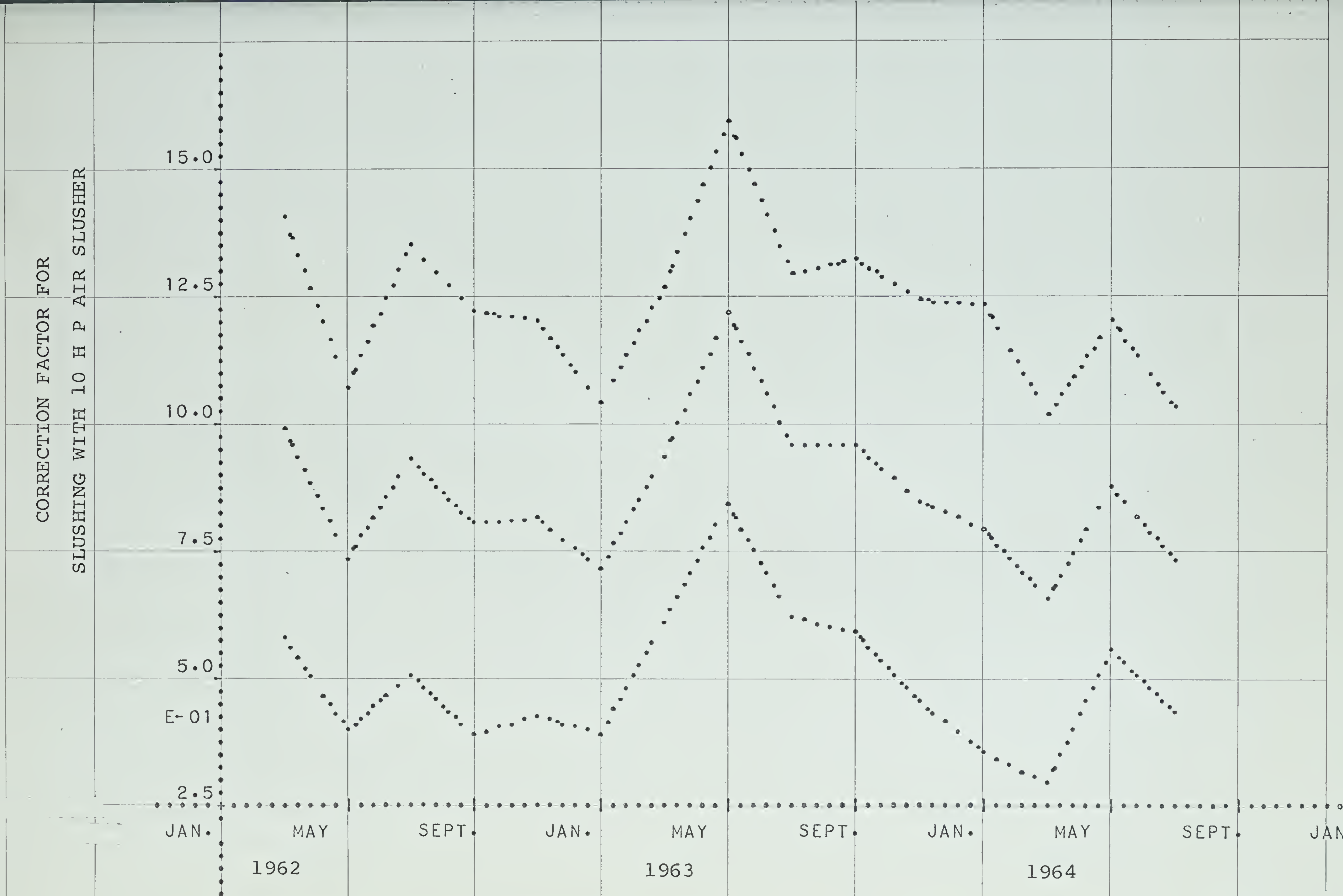

FIG. 30 - CORRECTION FACTOR FOR SLUSHING WITH 10 HP AIR VS. TIME

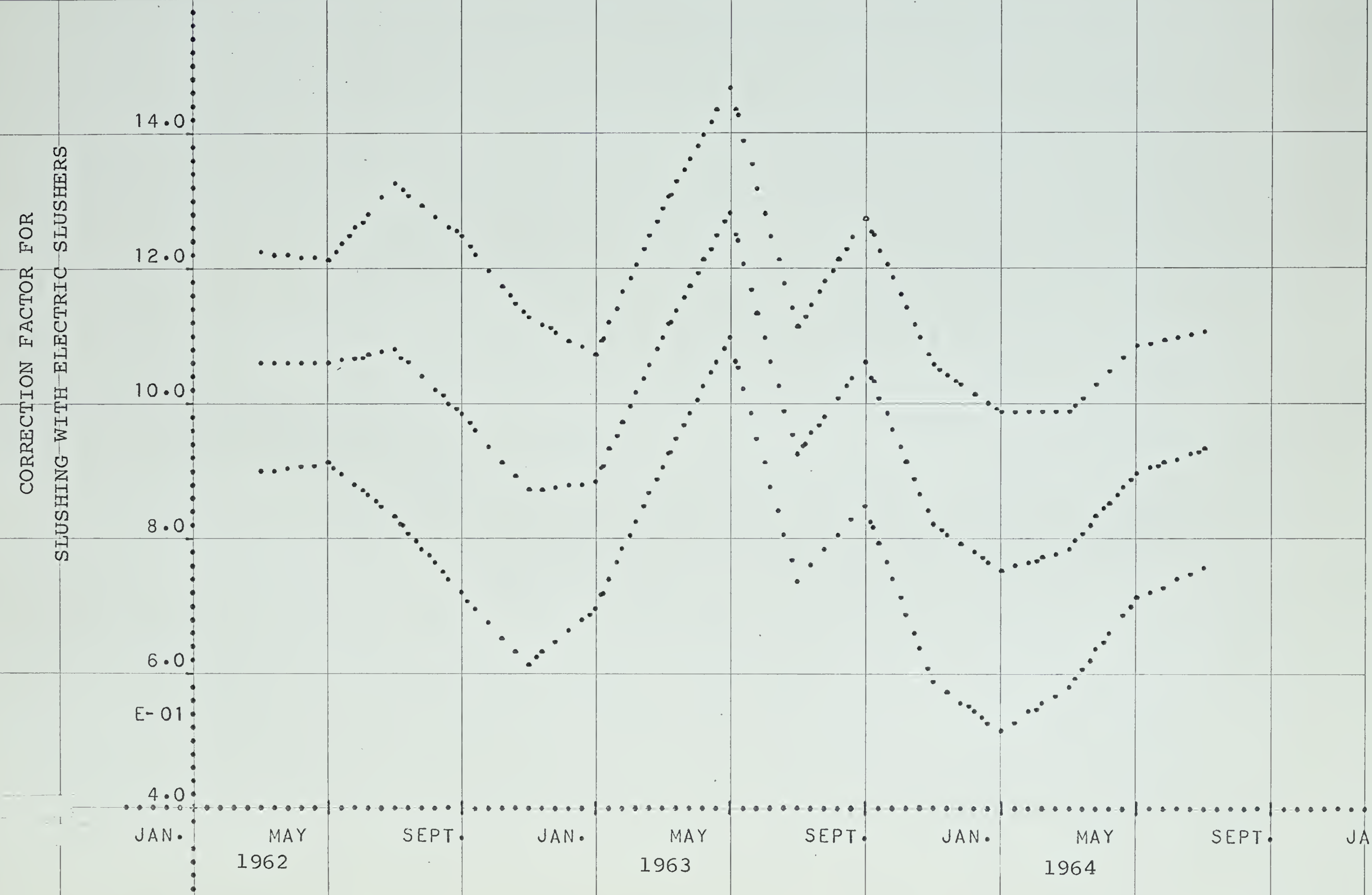

FIG. 31 - CORRECTION FACTOR FOR SLUSHING WITH ELECTRIC SLUSHERS VS. TIME

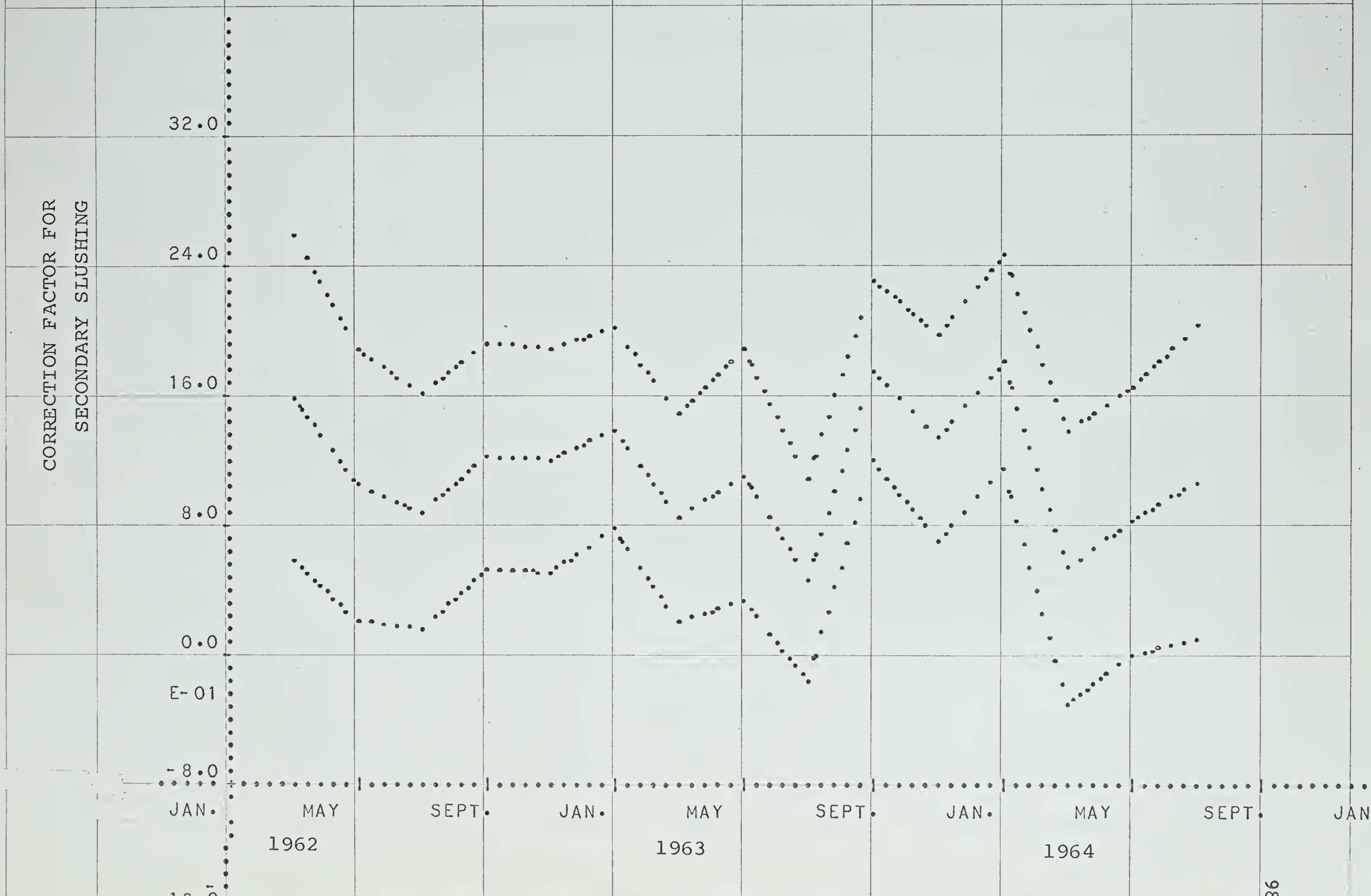

FIG. 32- CORRECTION FACTOR FOR SECONDARY SLUSHING VS. TIME

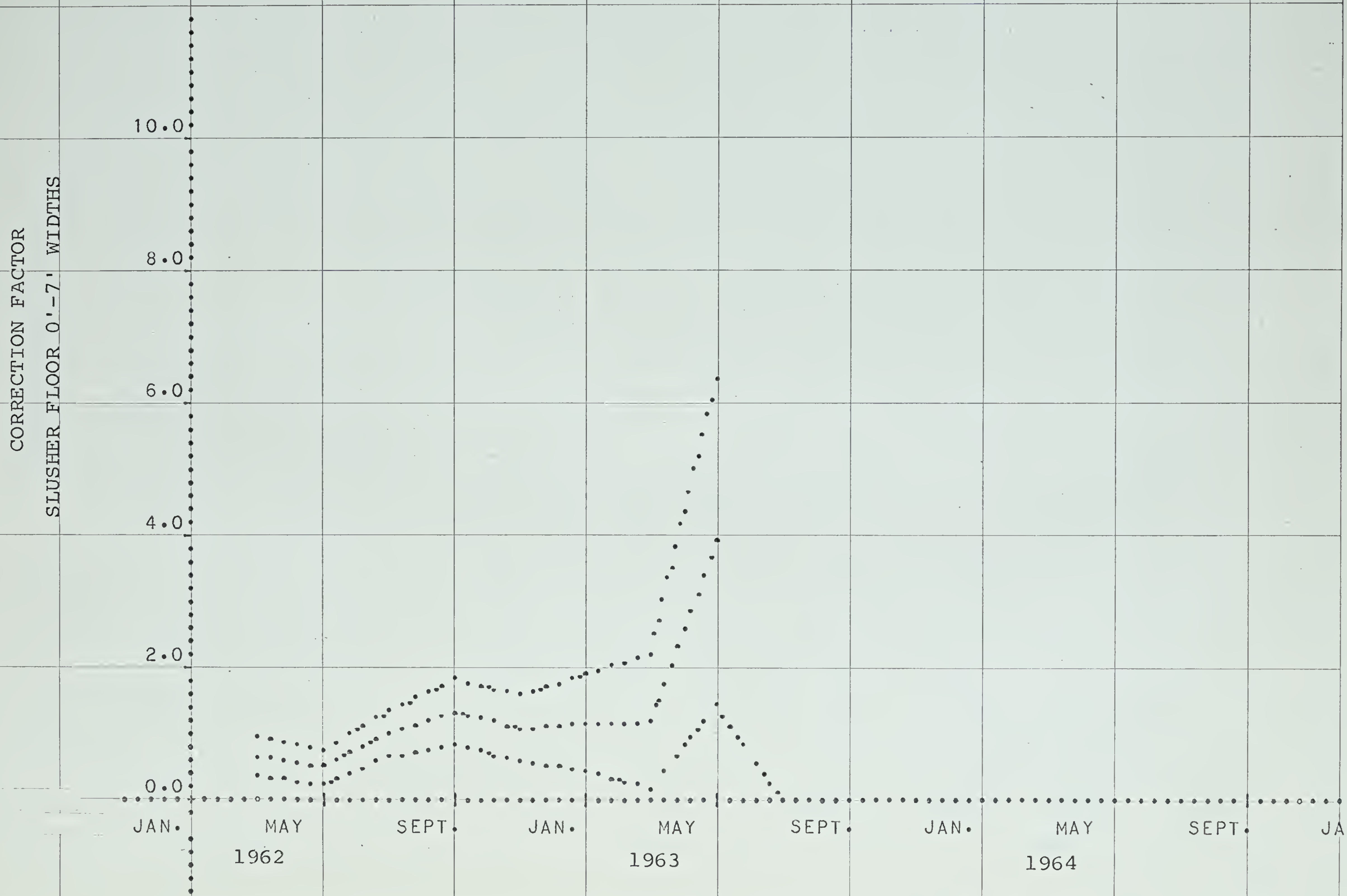

FIG. 33 - CORRECTION FACTOR FOR SLUSHER FLOOR 0'-7' WIDTHS VS. TIME

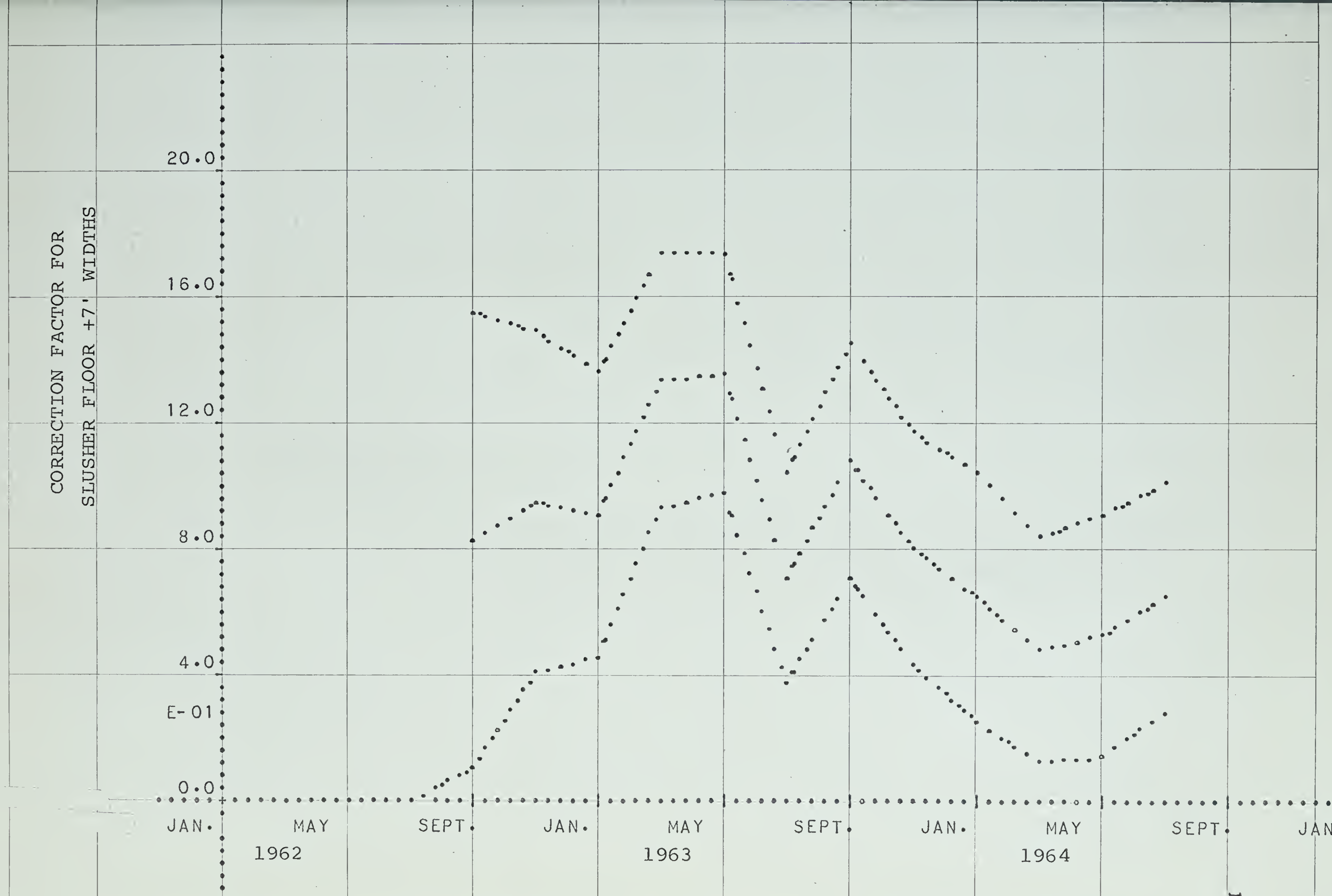

FIG. 34 - CORRECTION FACTOR FOR SLUSHER FLOOR + 7' WIDTHS VS. TIME

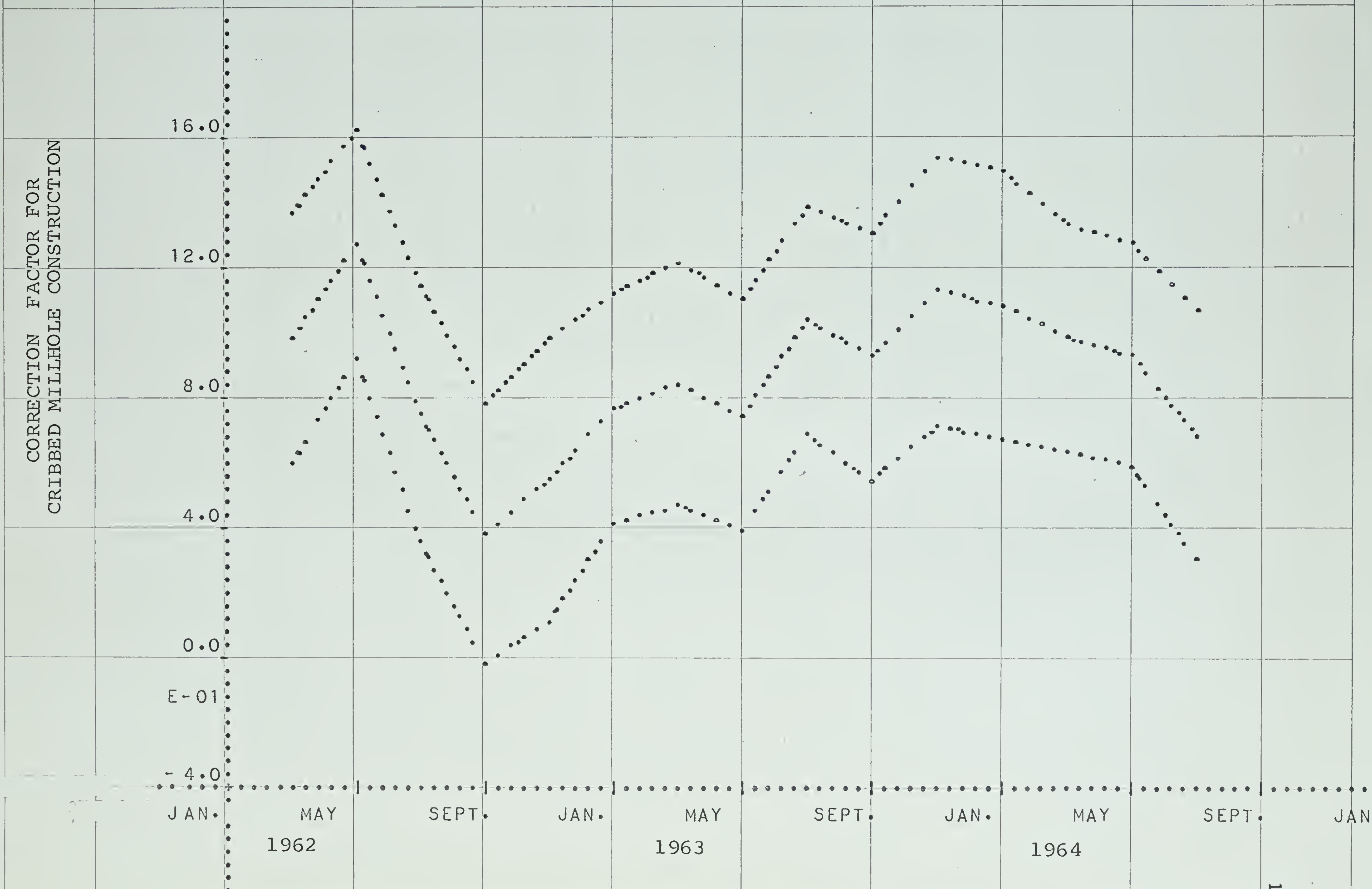

FIG. 35 – CORRECTION FACTOR FOR CRIBBED MILLHOLE CONSTRUCTION VS. TIME

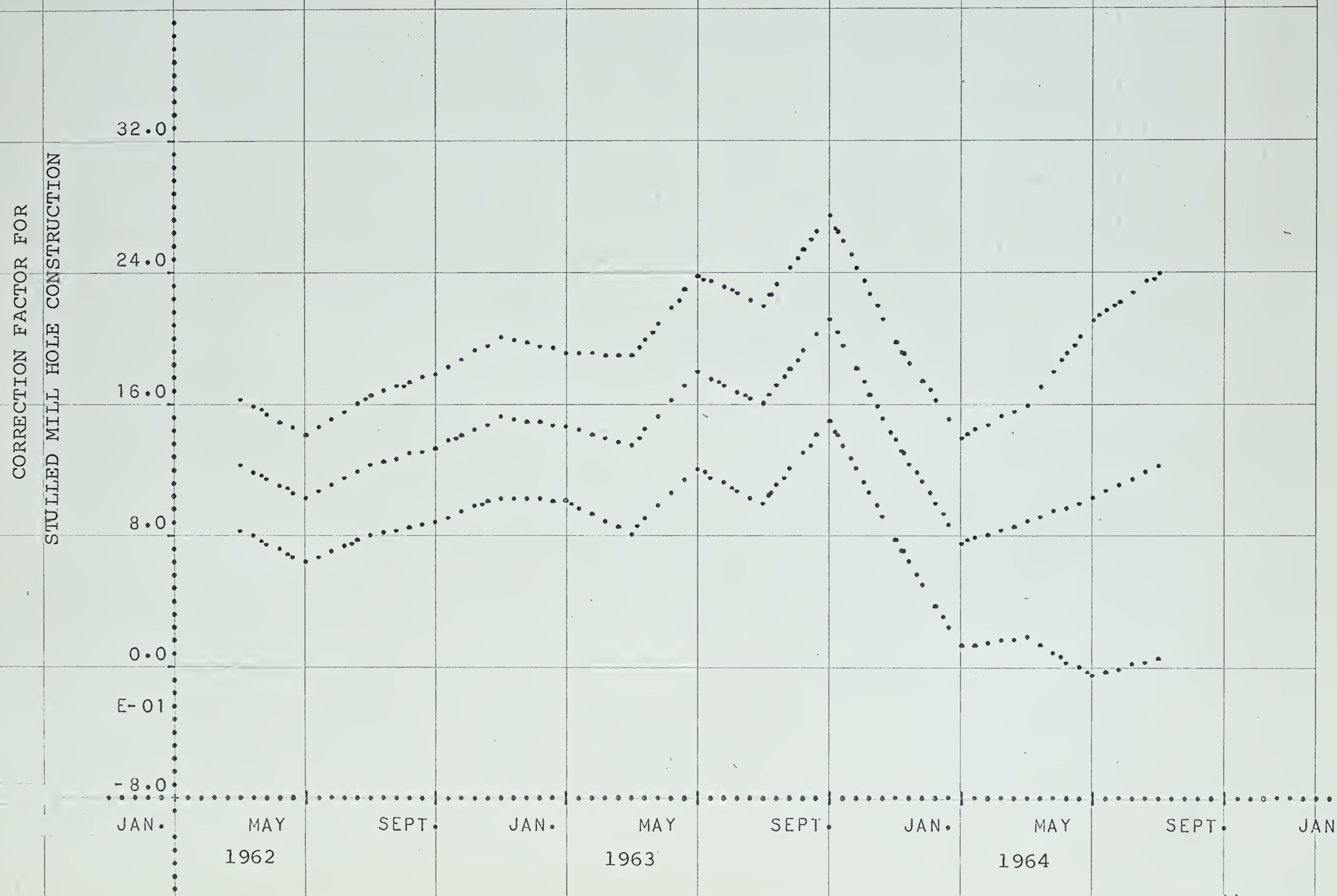

FIG. 36 - CORRECTION FACTOR FOR STULLED MILLHOLE CONSTRUCTION VS. TIME

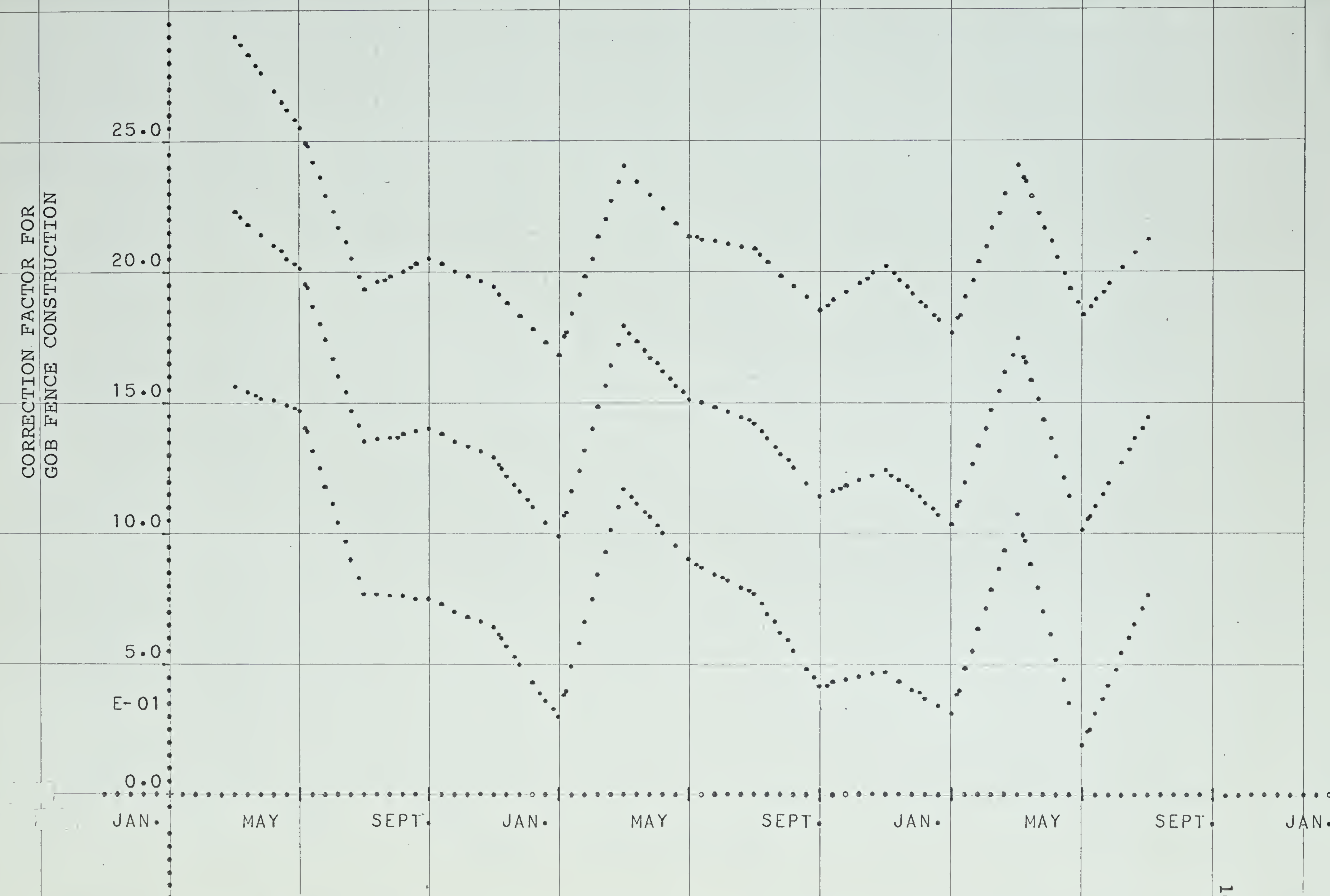

FIG. 37 - CORRECTION FACTOR FOR GOB FENCE CONSTRUCTION VS. TIME

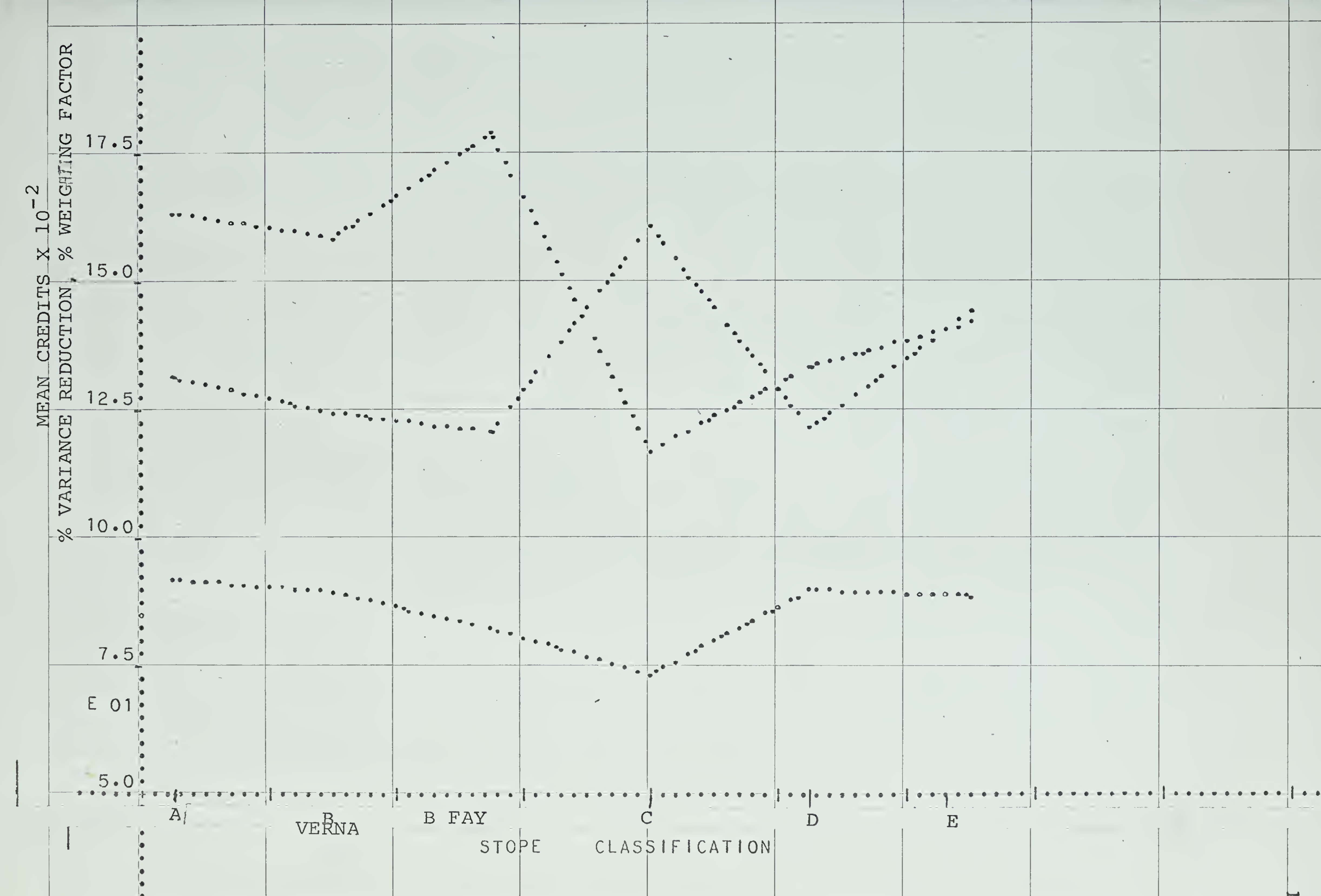

FIG. 38 - MEAN CREDITS, % VARIANCE REDUCTION, WEIGHTING FACTOR VS. STOPE CLASS

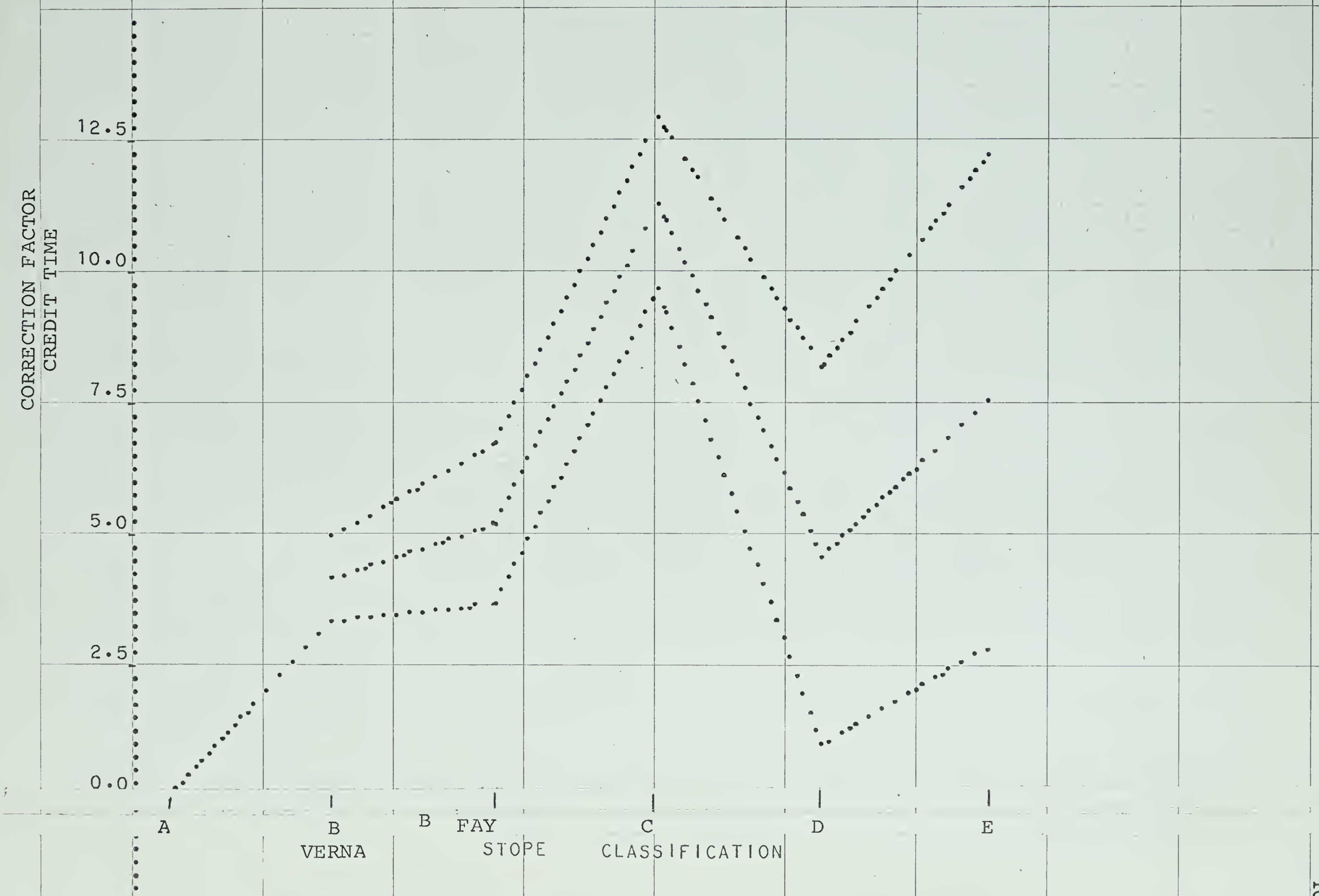

FIG. 39 - CORRECTION FACTOR FOR CREDIT TIME VS. STOPE CLASS

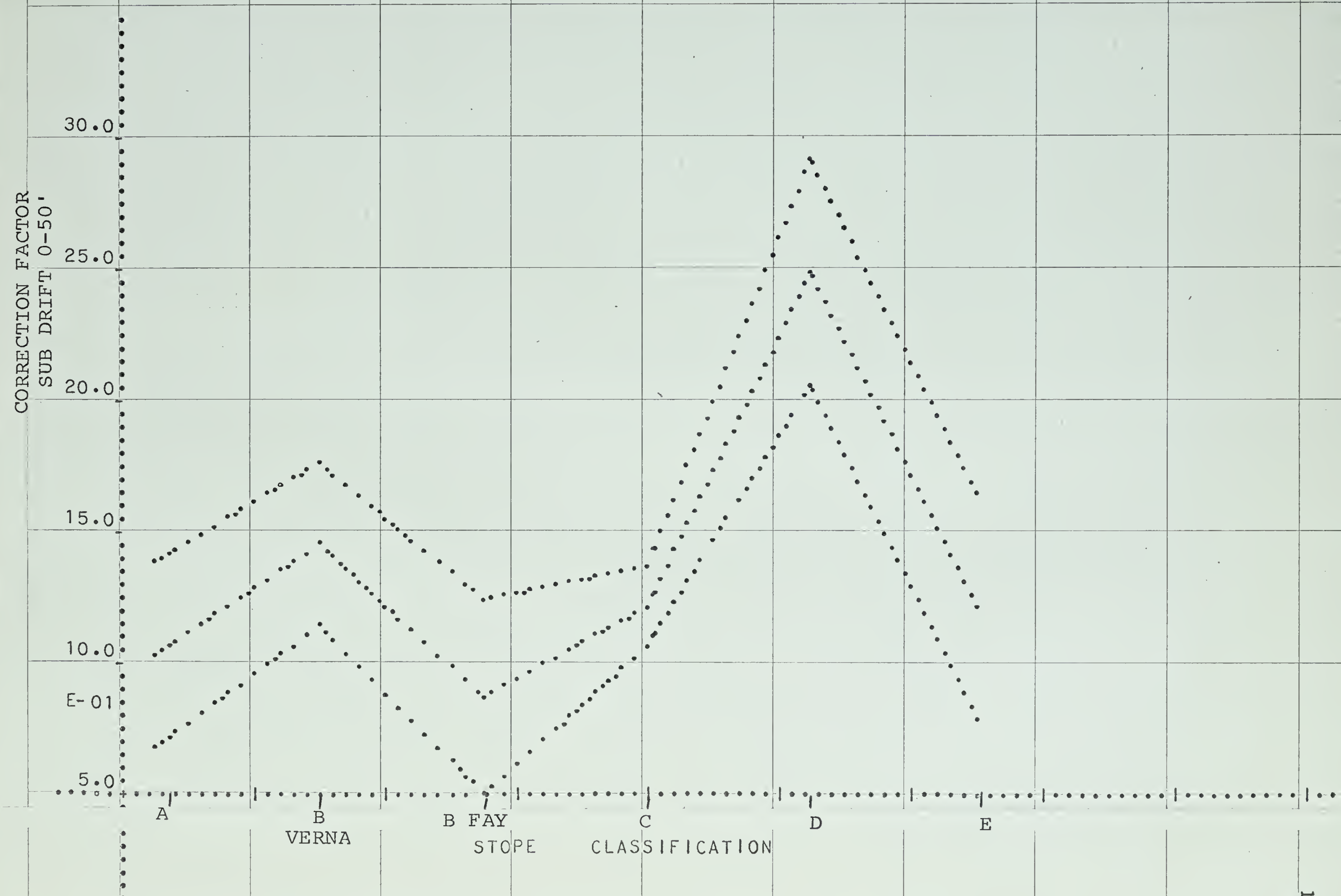

FIG. 40 - CORRECTION FACTOR FOR SUB DRIFT -'-50' VS. STOPE CLASS

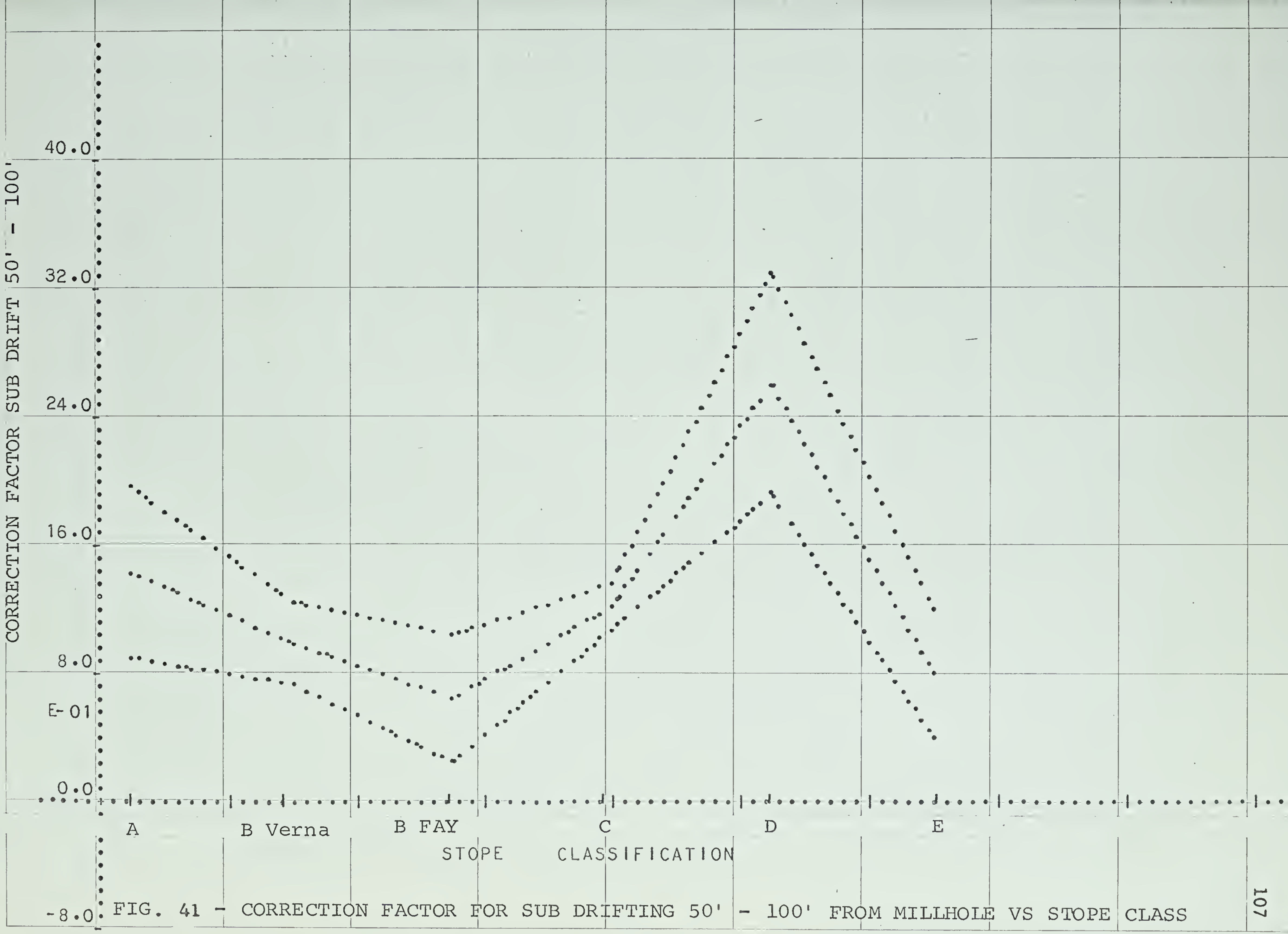

FIG. 41 - CORRECTION FACTOR FOR SUB DRIFTING 50' - 100' FROM MILLHOLE VS STOPE CLASS

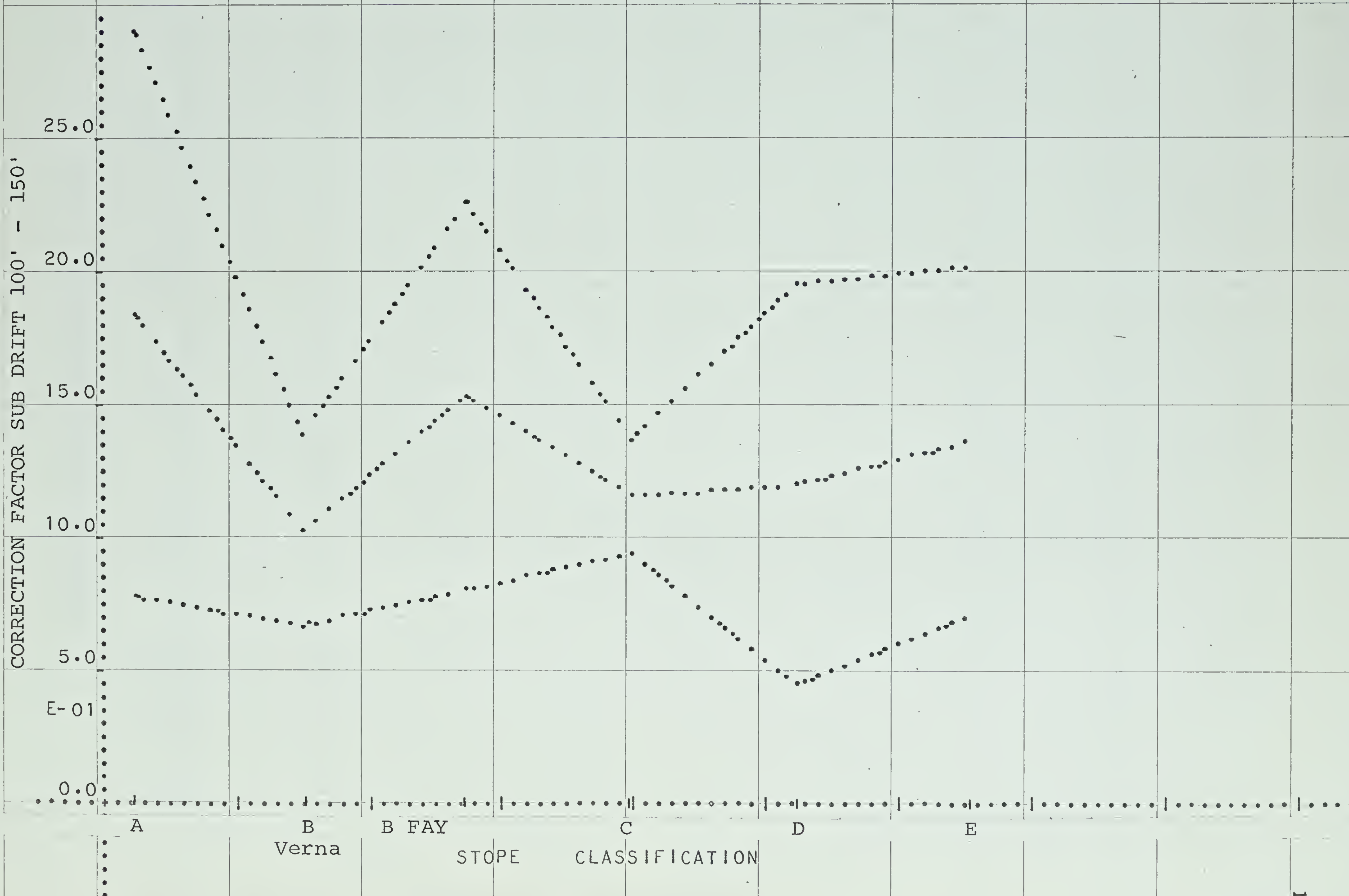

FIG. 42 – CORRECTION FACTOR FOR SUB DRIFTING 100' - 150' FROM MILLHOLE VS STOPE CLASS

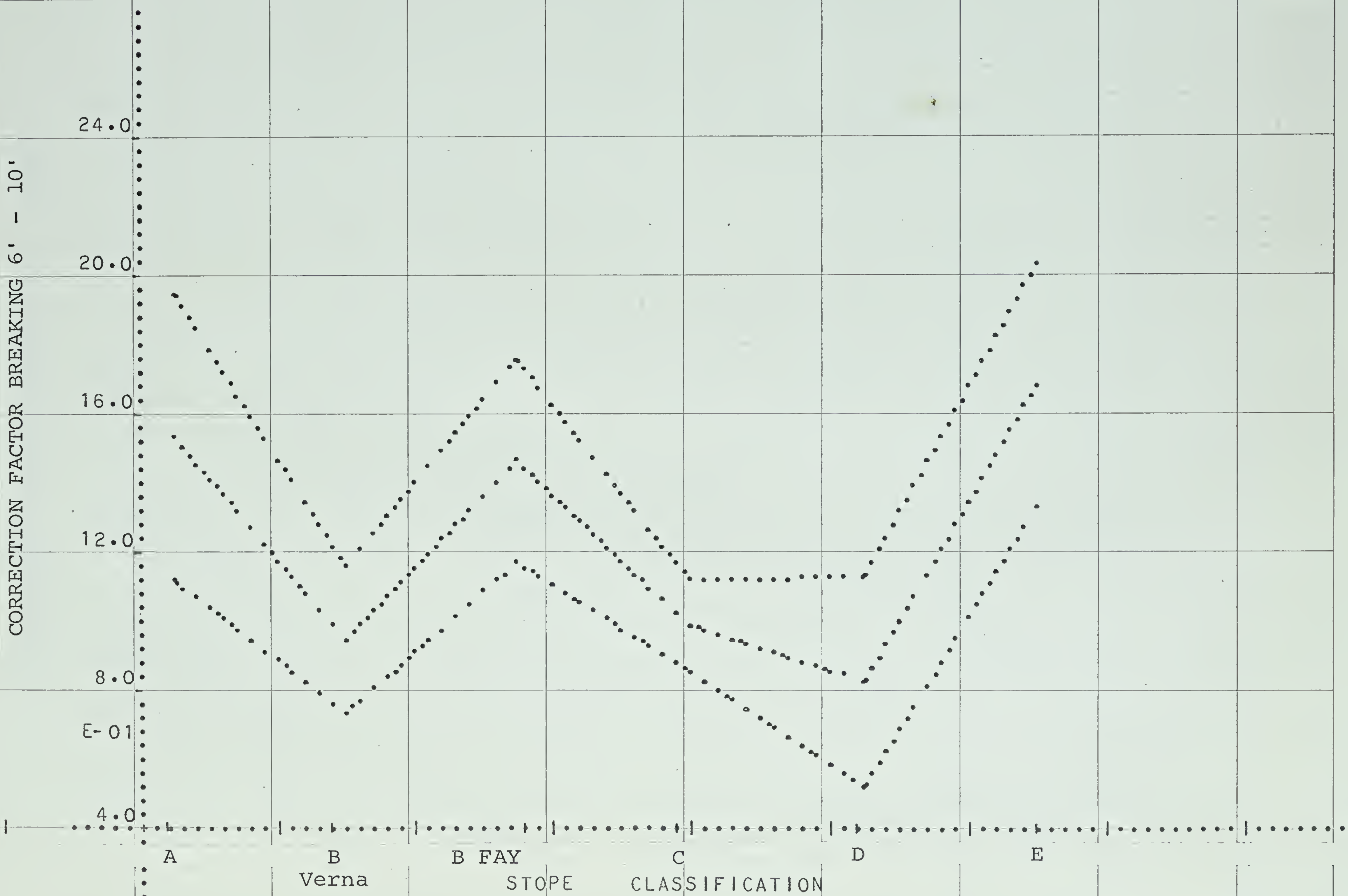

FIG. 43 - CORRECTION FACTOR FOR BREAKING 6' - 10' VS SLOPE CLASS

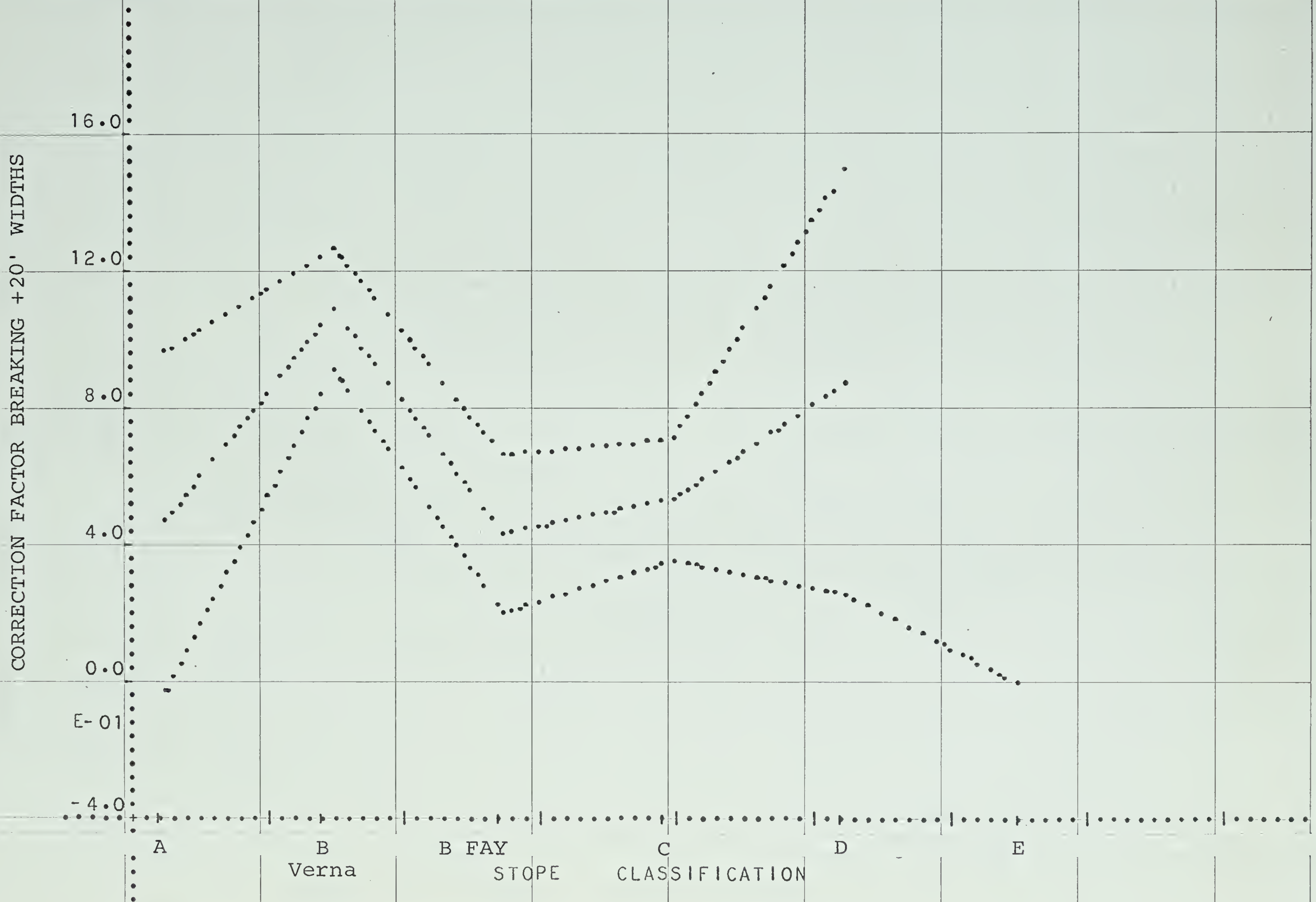

FIG. 44 - CORRECTION FACTOR FOR BREAKING +20' WIDTHS VS STOPE CLASS

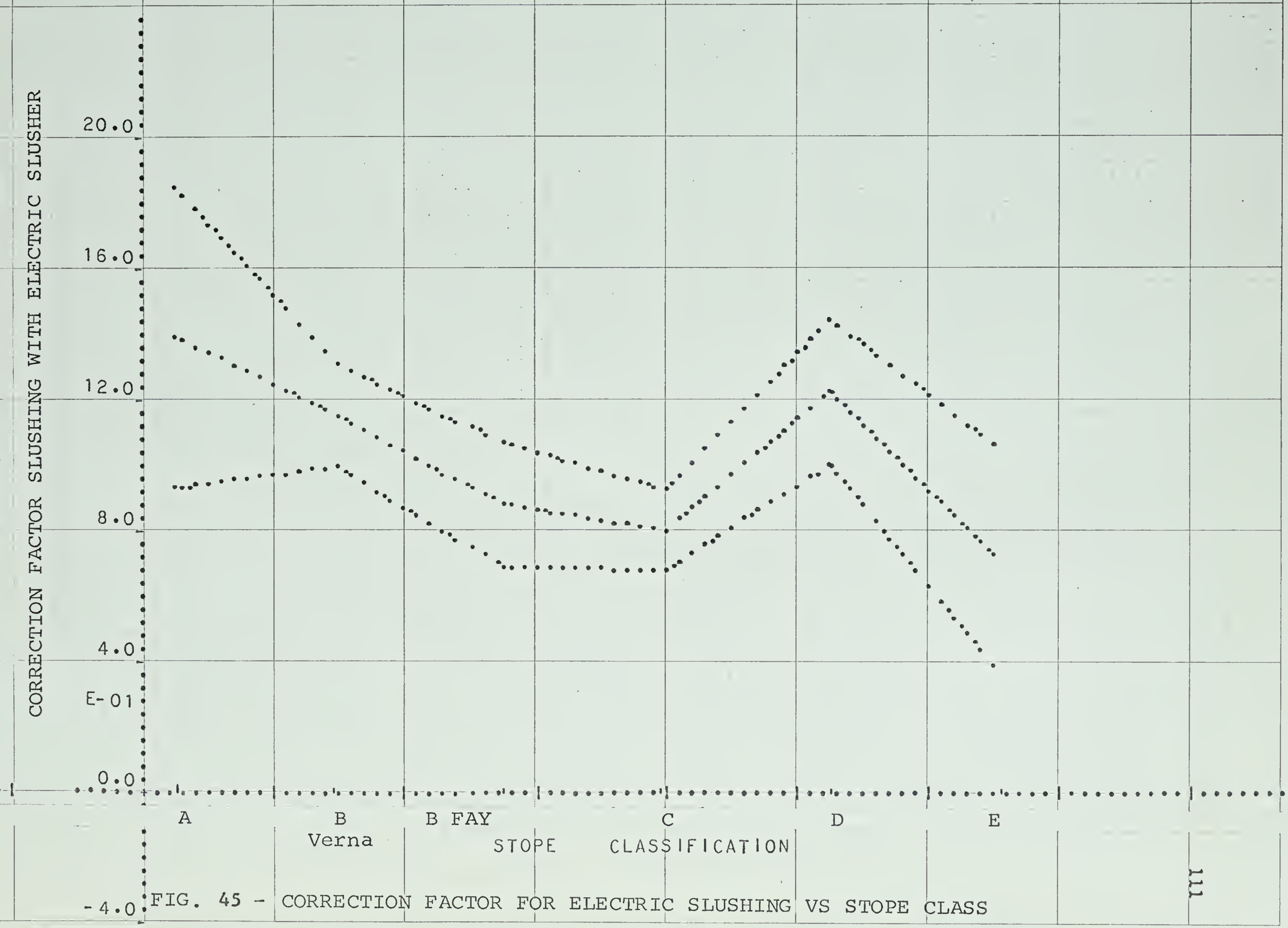

FIG. 45 - CORRECTION FACTOR FOR ELECTRIC SLUSHING VS STOPE CLASS

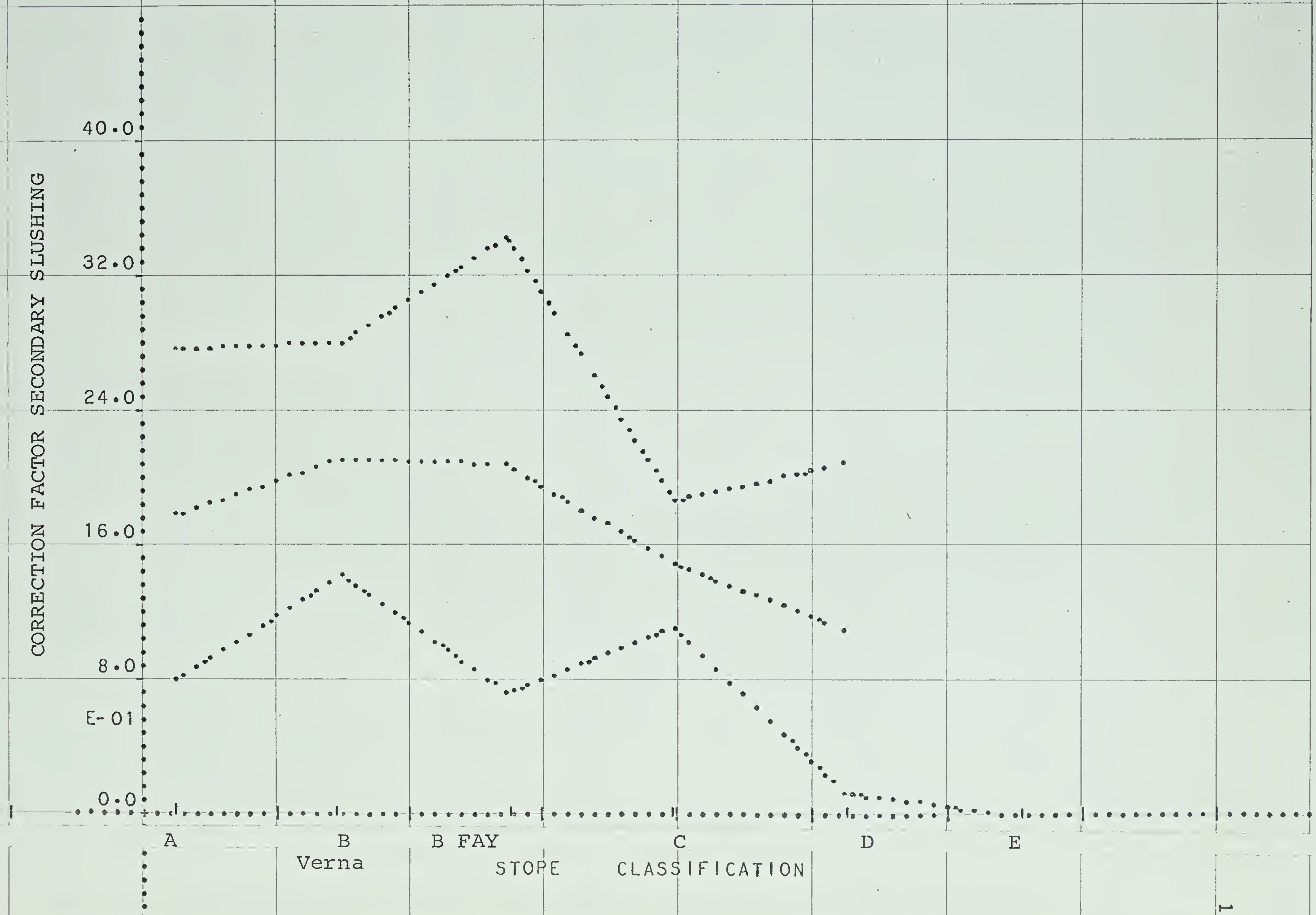

FIG. 46 - CORRECTION FACTOR FOR SECONDARY SLUSHING VS STOPE CLASS

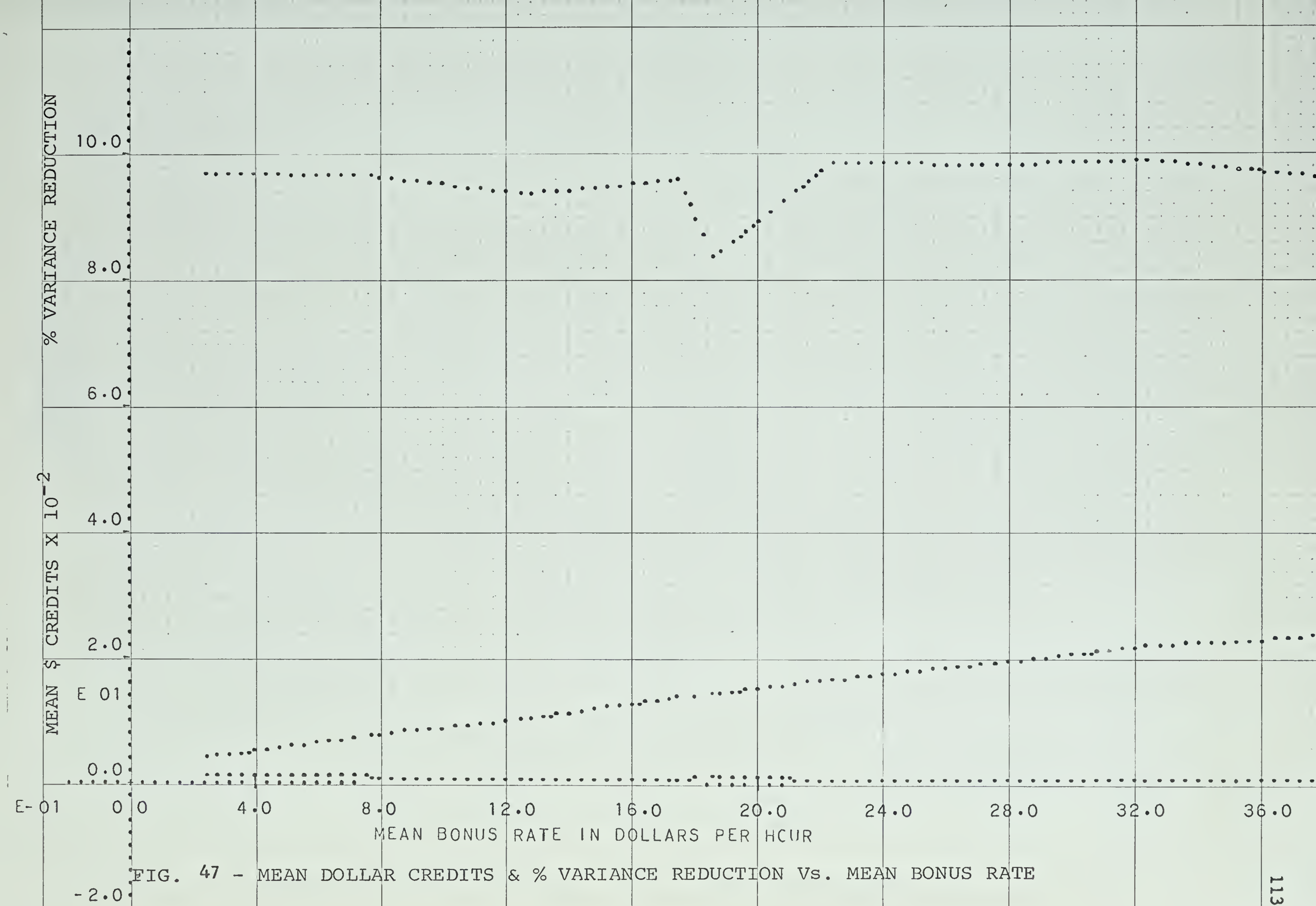

FIG. 47 - MEAN DOLLAR CREDITS & % VARIANCE REDUCTION Vs. MEAN BONUS RATE

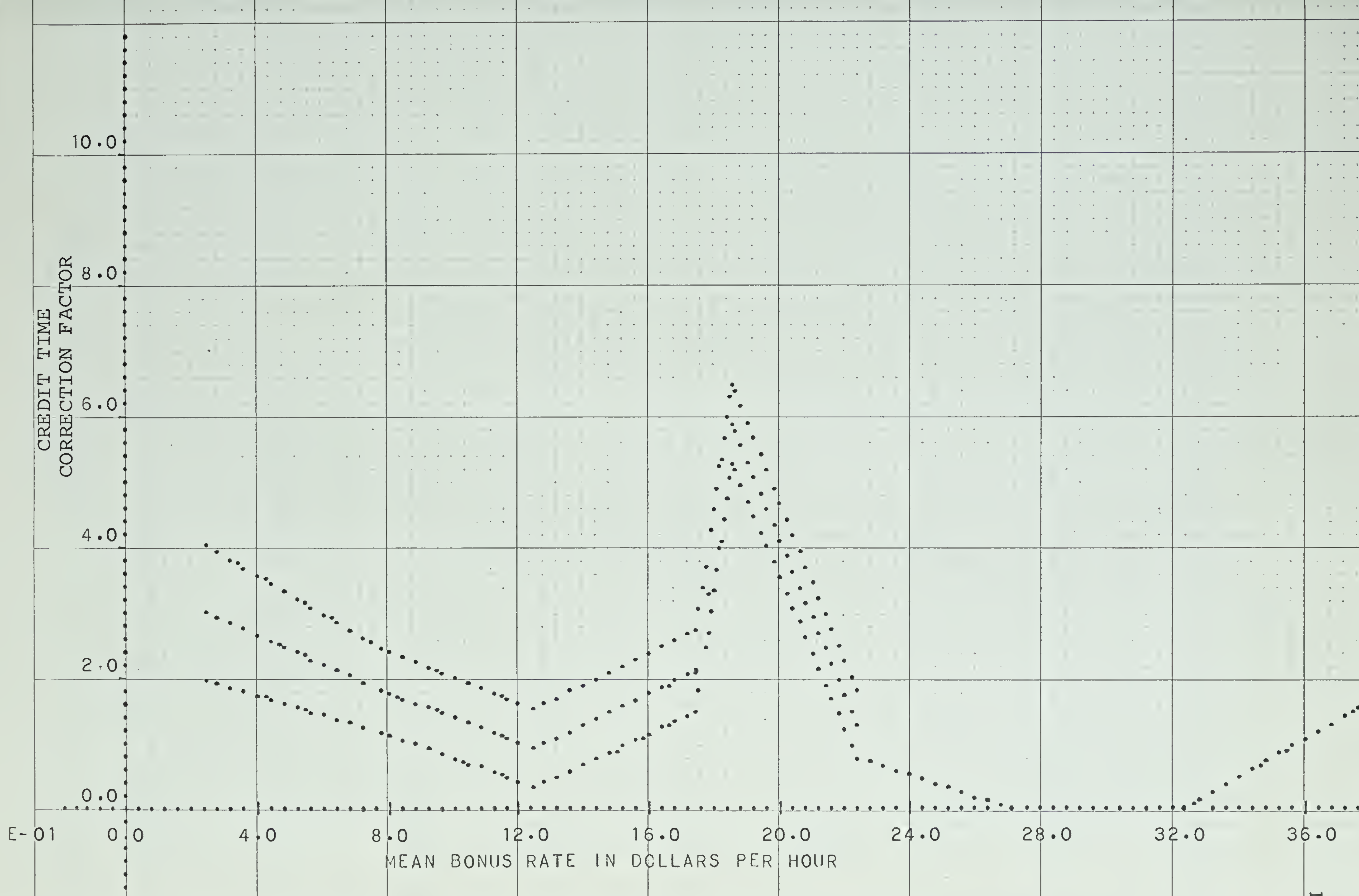

FIG. 48 - CORRECTION FACTOR FOR CREDIT TIME Vs.MEAN BONUS RATE

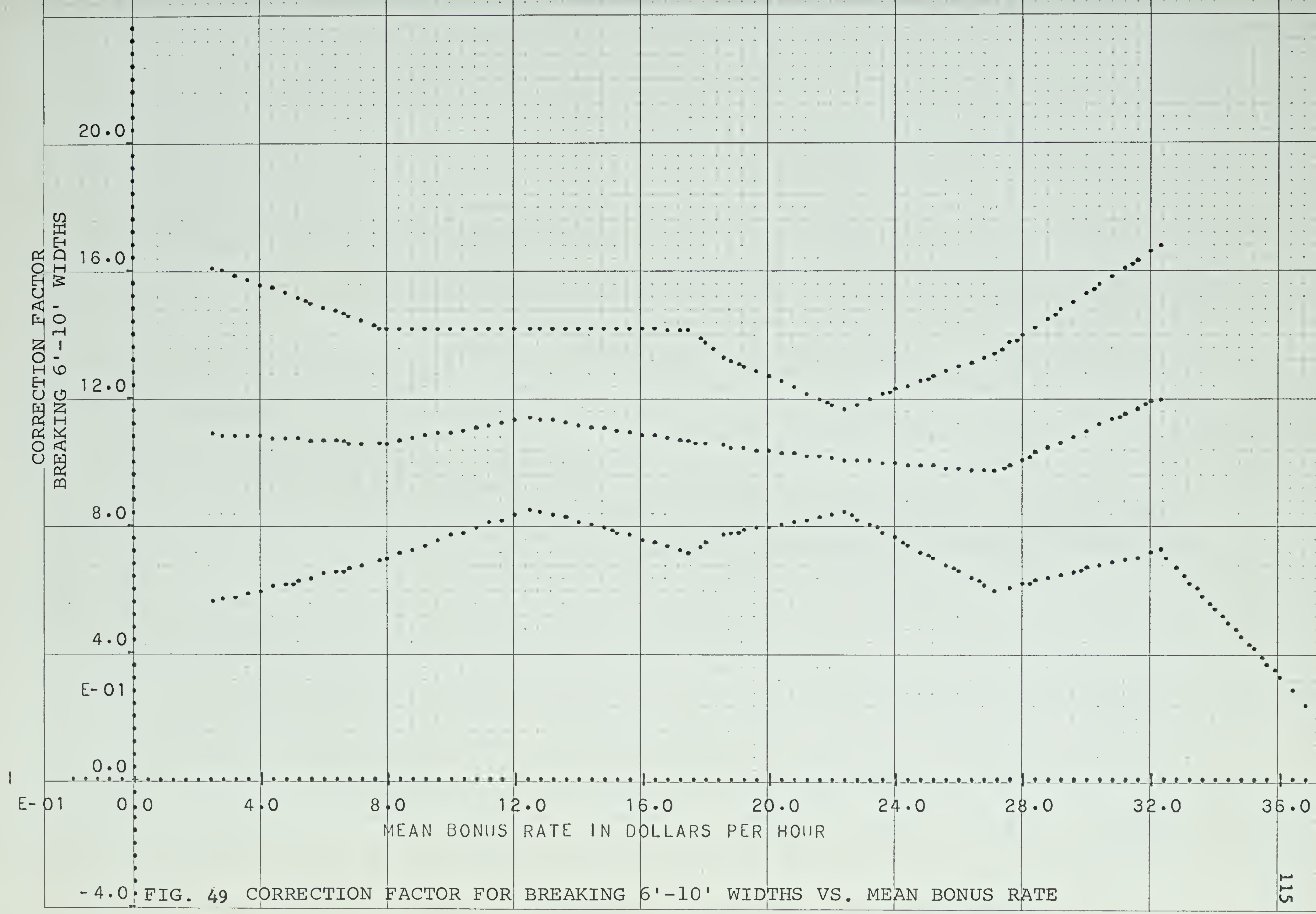

FIG. 49 CORRECTION FACTOR FOR BREAKING 6'-10' WIDTHS VS. MEAN BONUS RATE

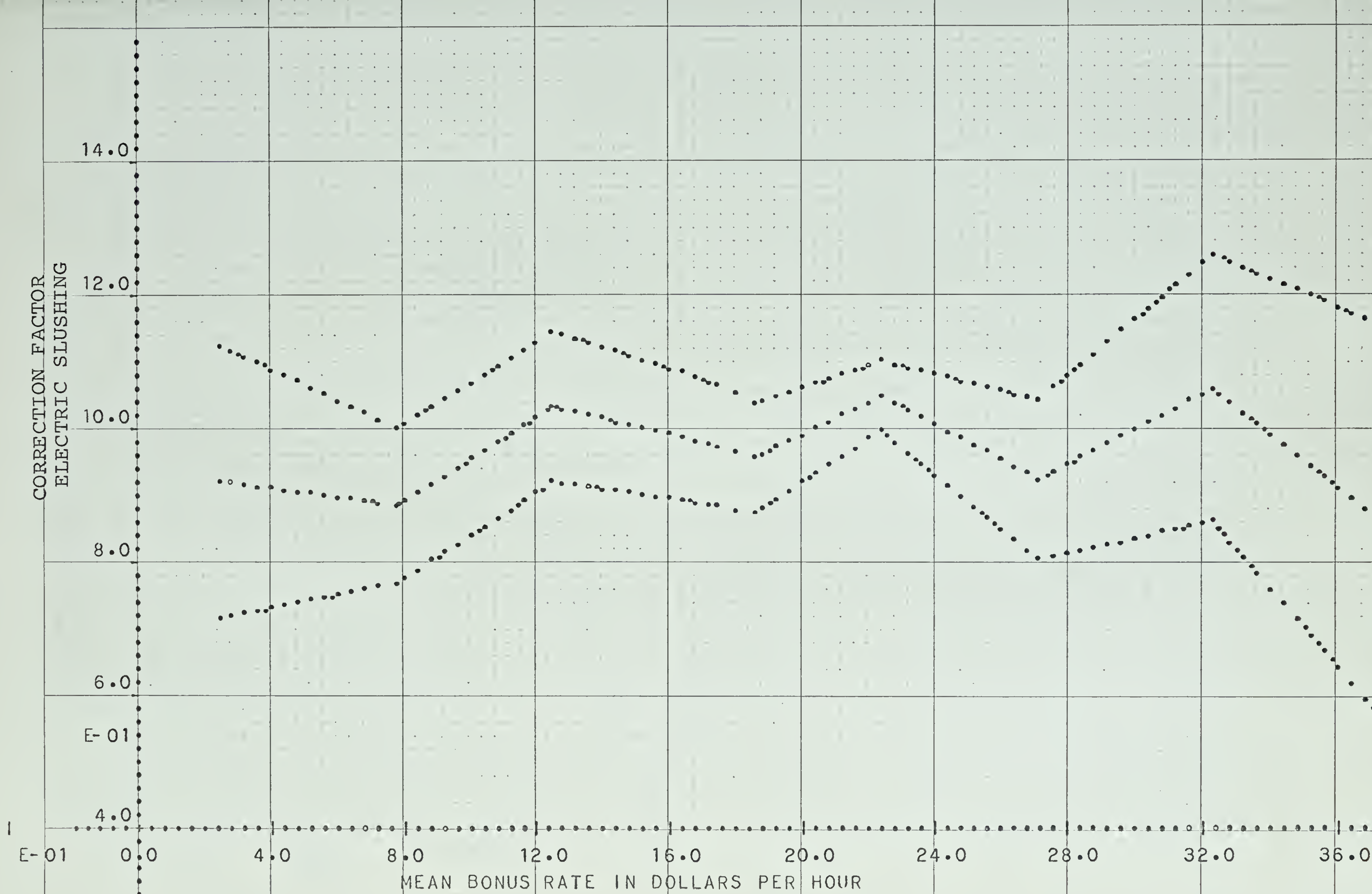

FIG. 50 - CORRECTION FACTOR FOR ELECTRIC SLUSHING VS. MEAN BONUS RATE

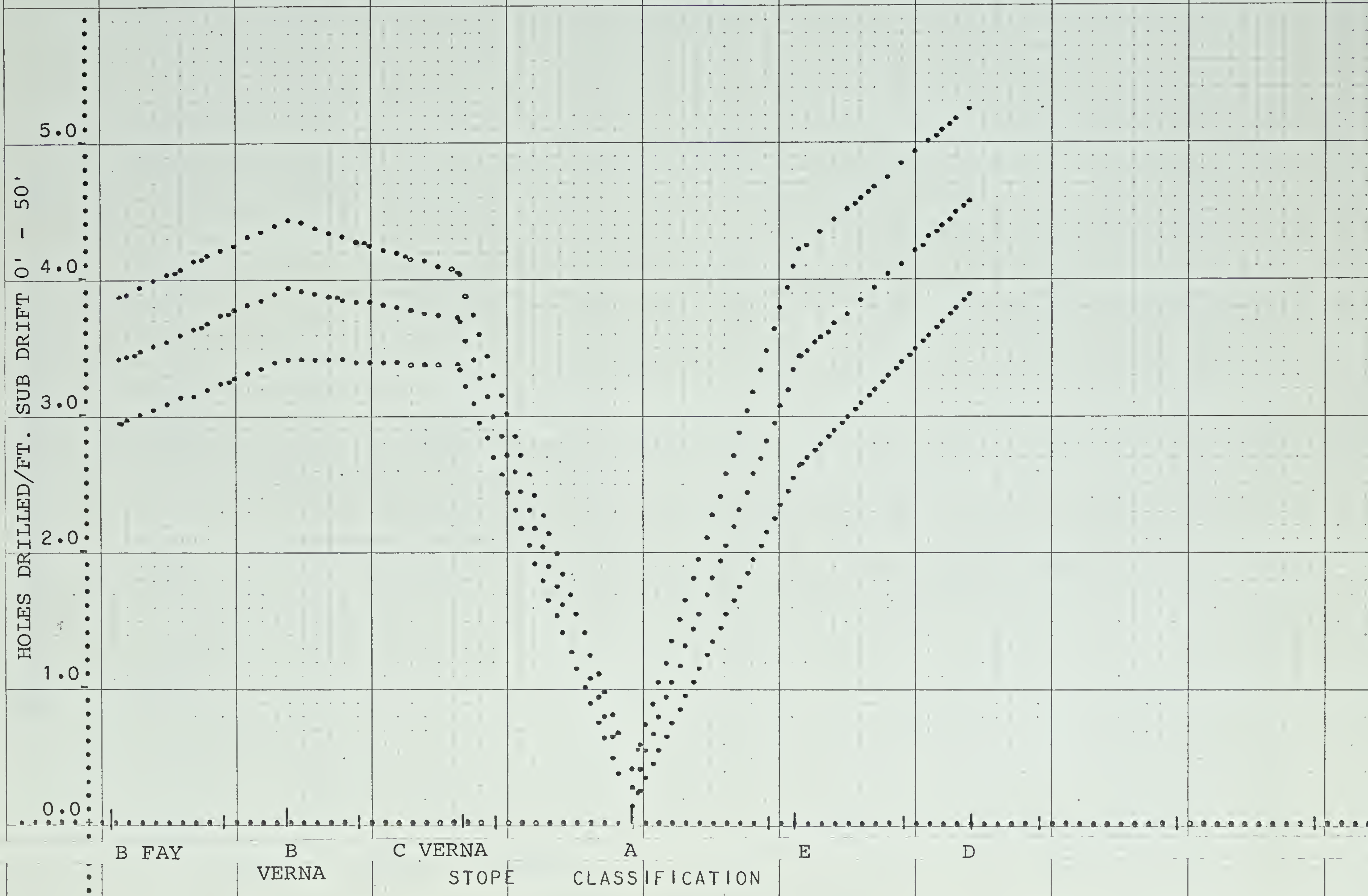

FIG. 51 - HOLES DRILLED PER FOOT OF SUB DRIFT 0' - 50' VS STOPE CLASS

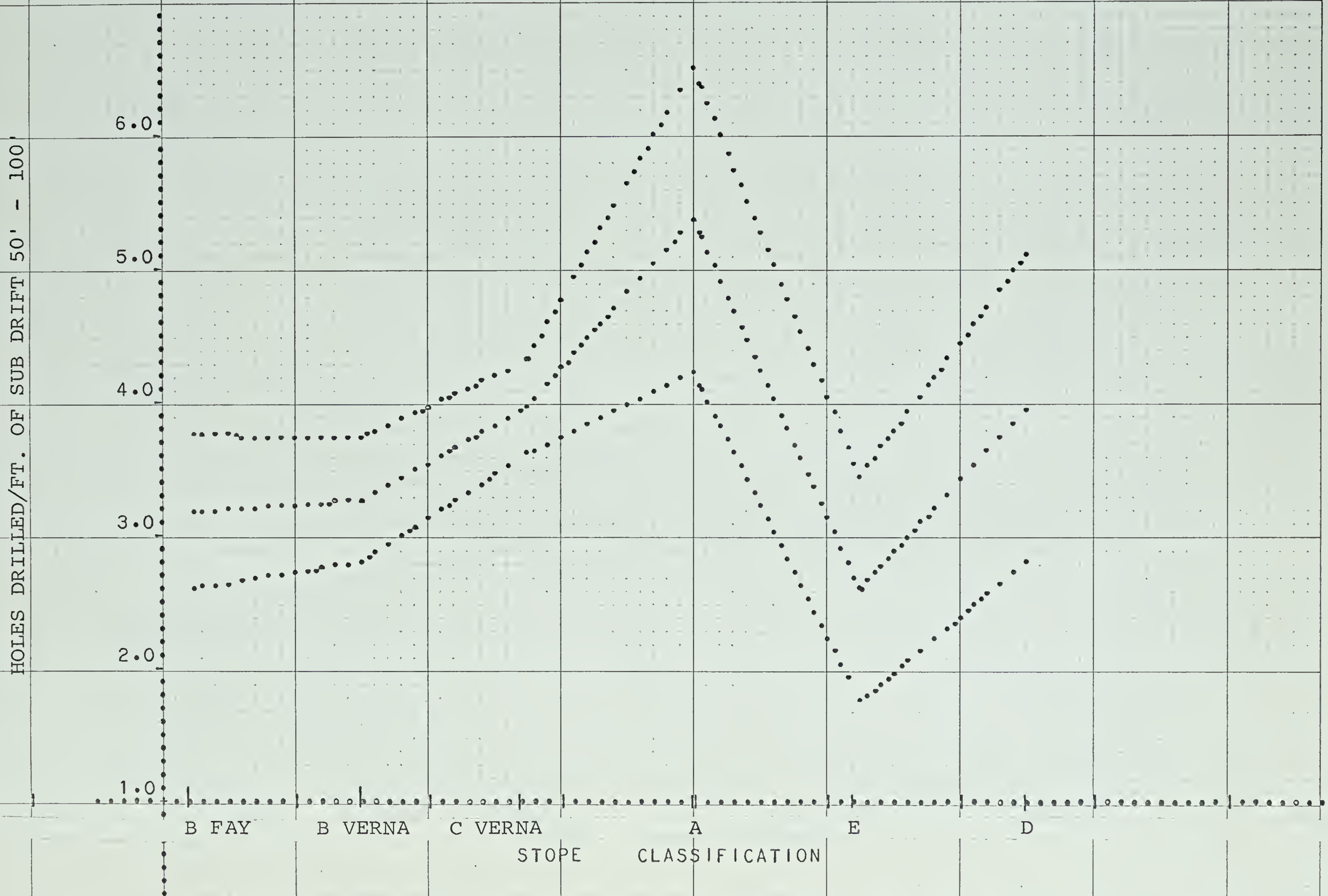

FIG. 52 - HOLES DRILLED PER FOOT OF SUB DRIFT 50' - 100' VS STOPE CLASS

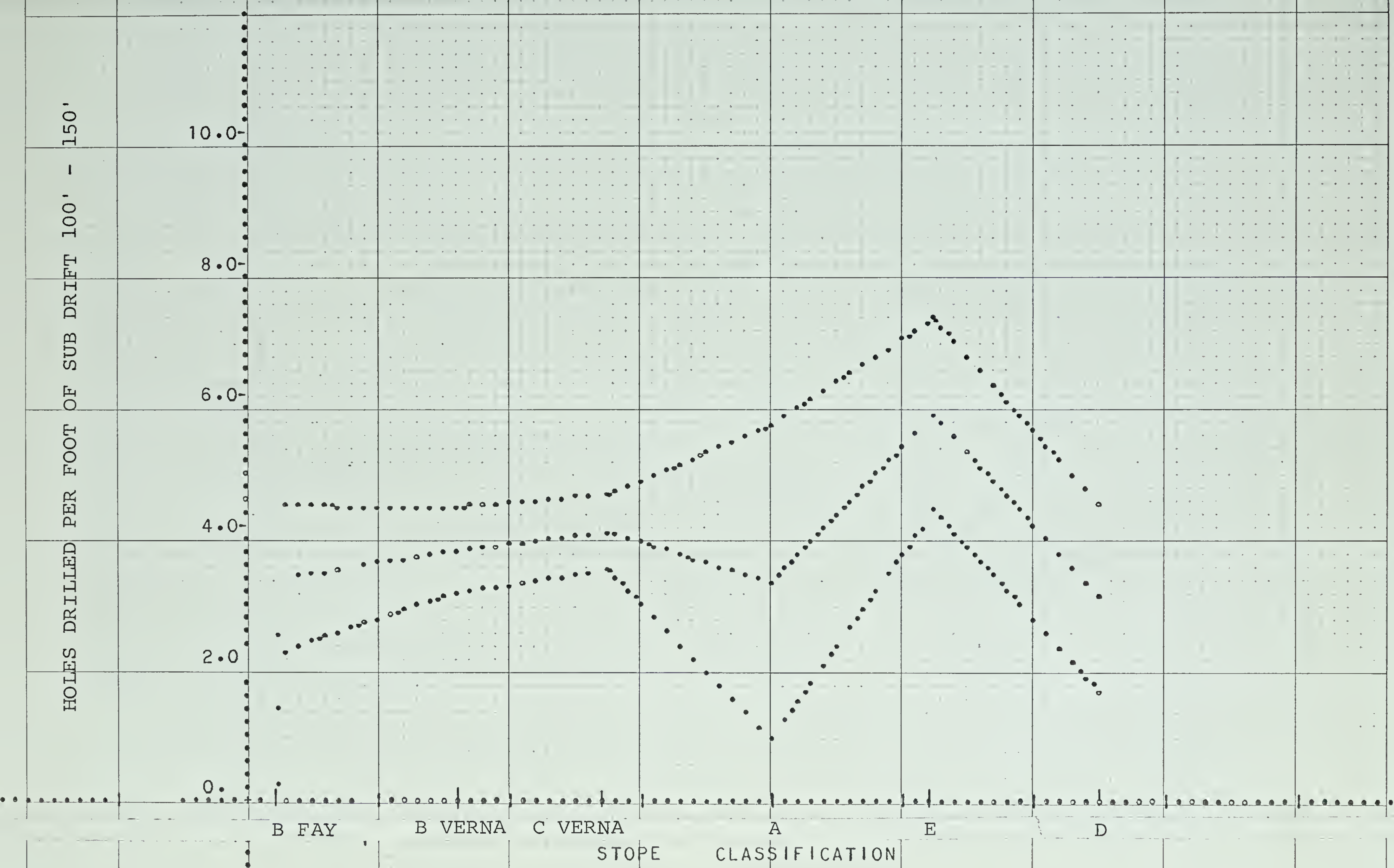

FIG. 53 - HOLES DRILLED PER FOOT OF SUB DRIFT 100' - 150' VS STOPE CLASS

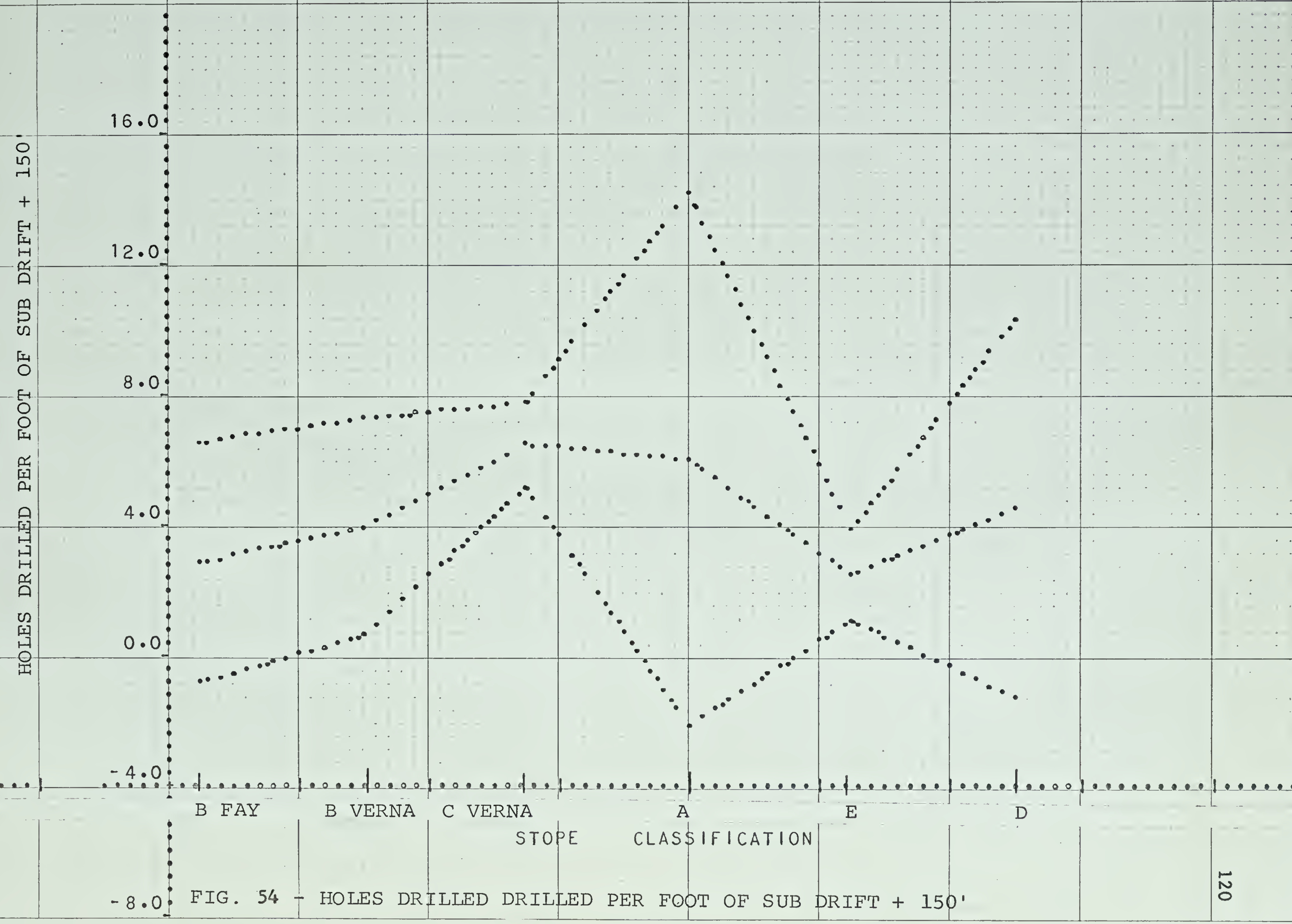

FIG. 54 - HOLES DRILLED DRILLED PER FOOT OF SUB DRIFT + 150'

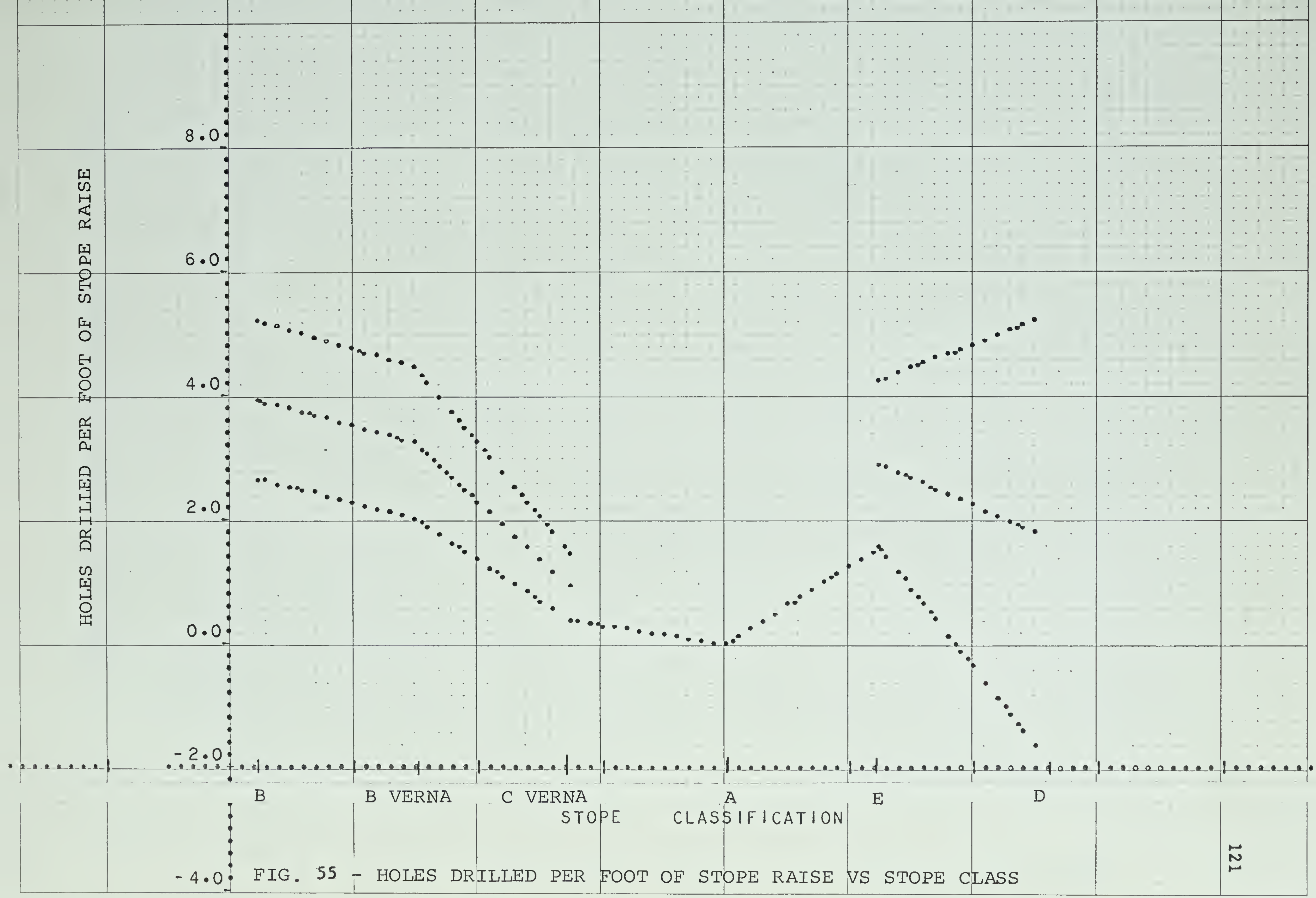

FIG. 55 - HOLES DRILLED PER FOOT OF STOPE RAISE VS STOPE CLASS

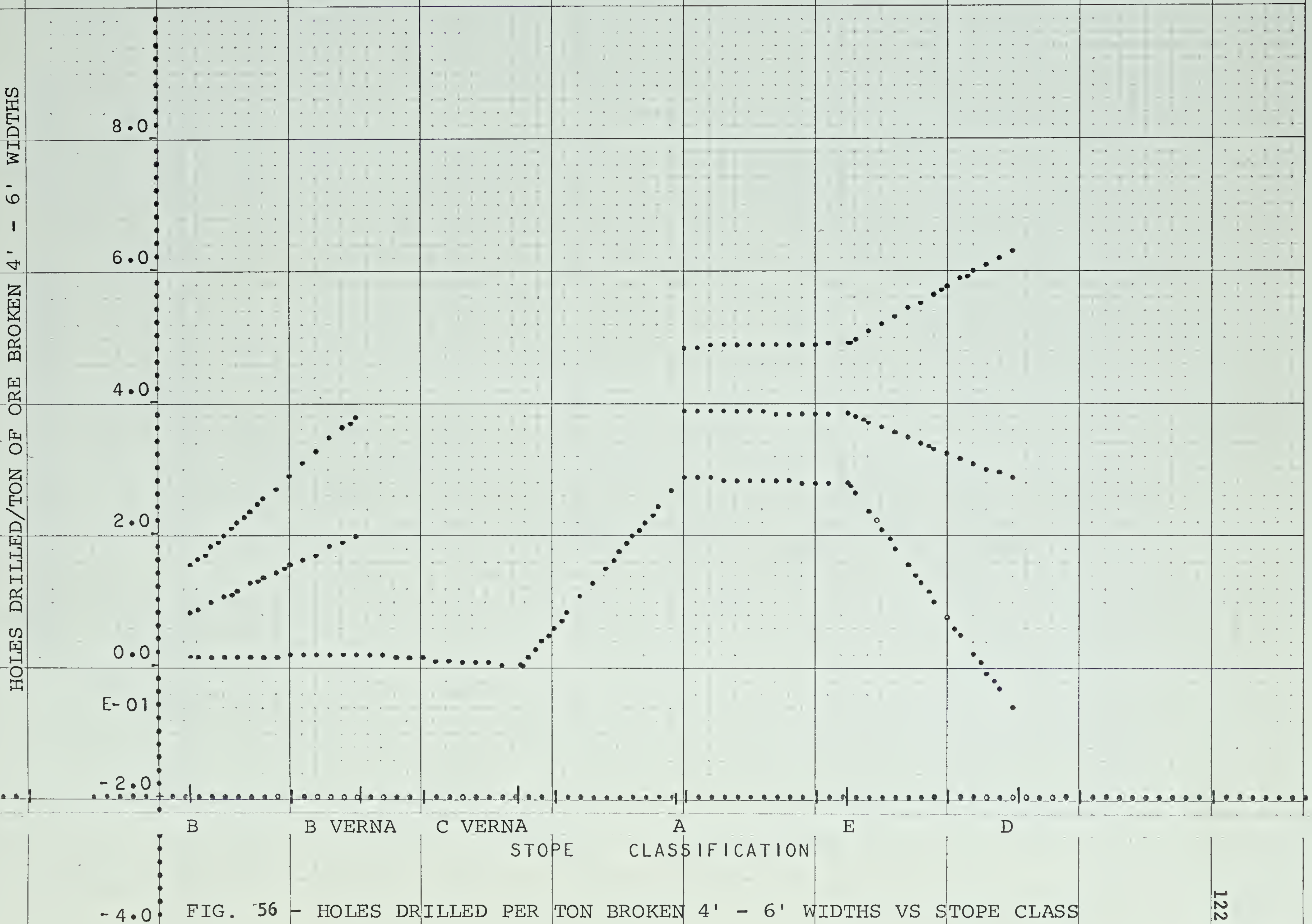

FIG. 56 - HOLES DRILLED PER TON BROKEN 4' - 6' WIDTHS VS STOPE CLASS

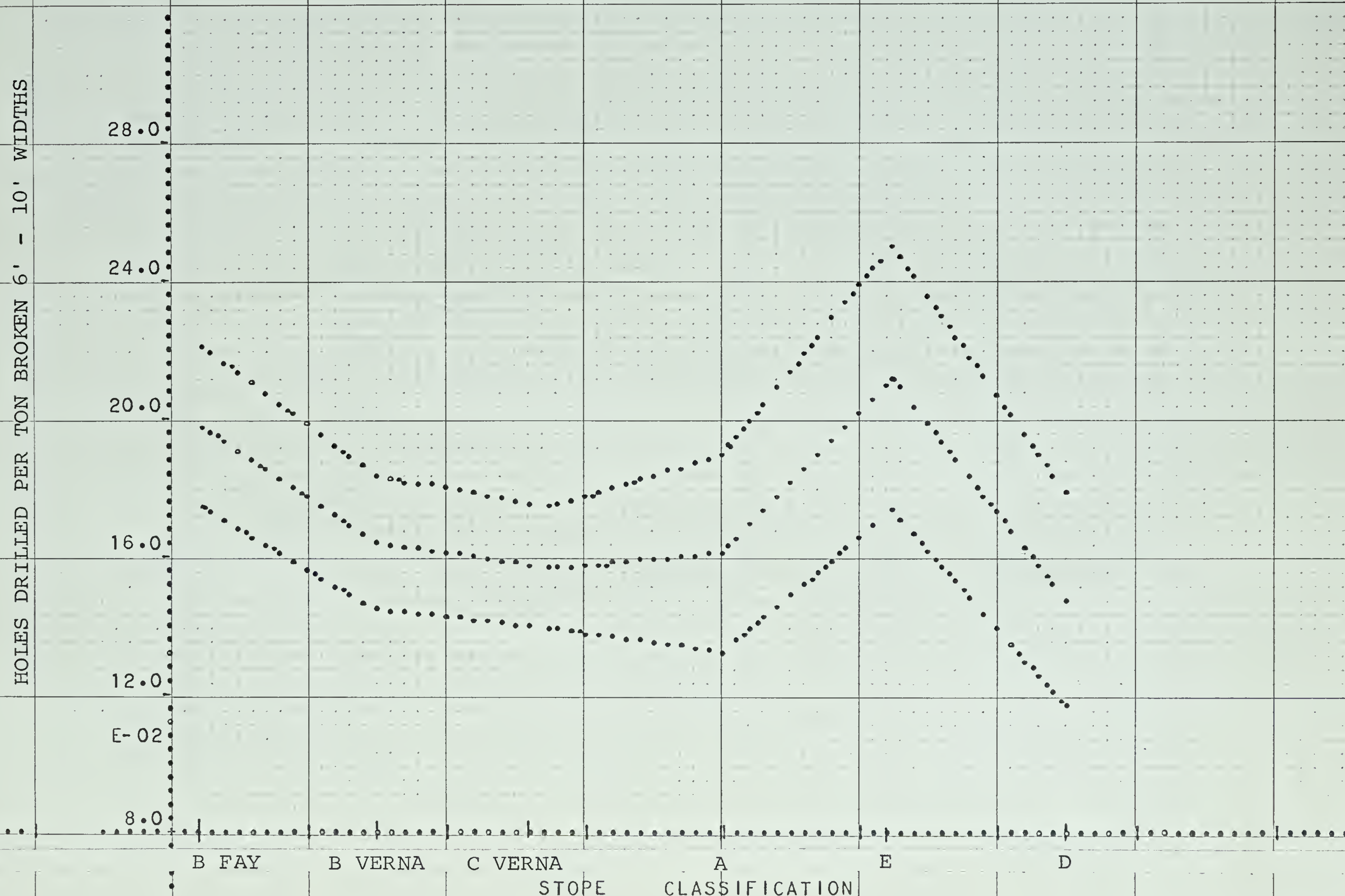

FIG 57 - HOLES DRILLED PER TON BROKEN 6' - 10' WIDTHS VS STOPE CLASS

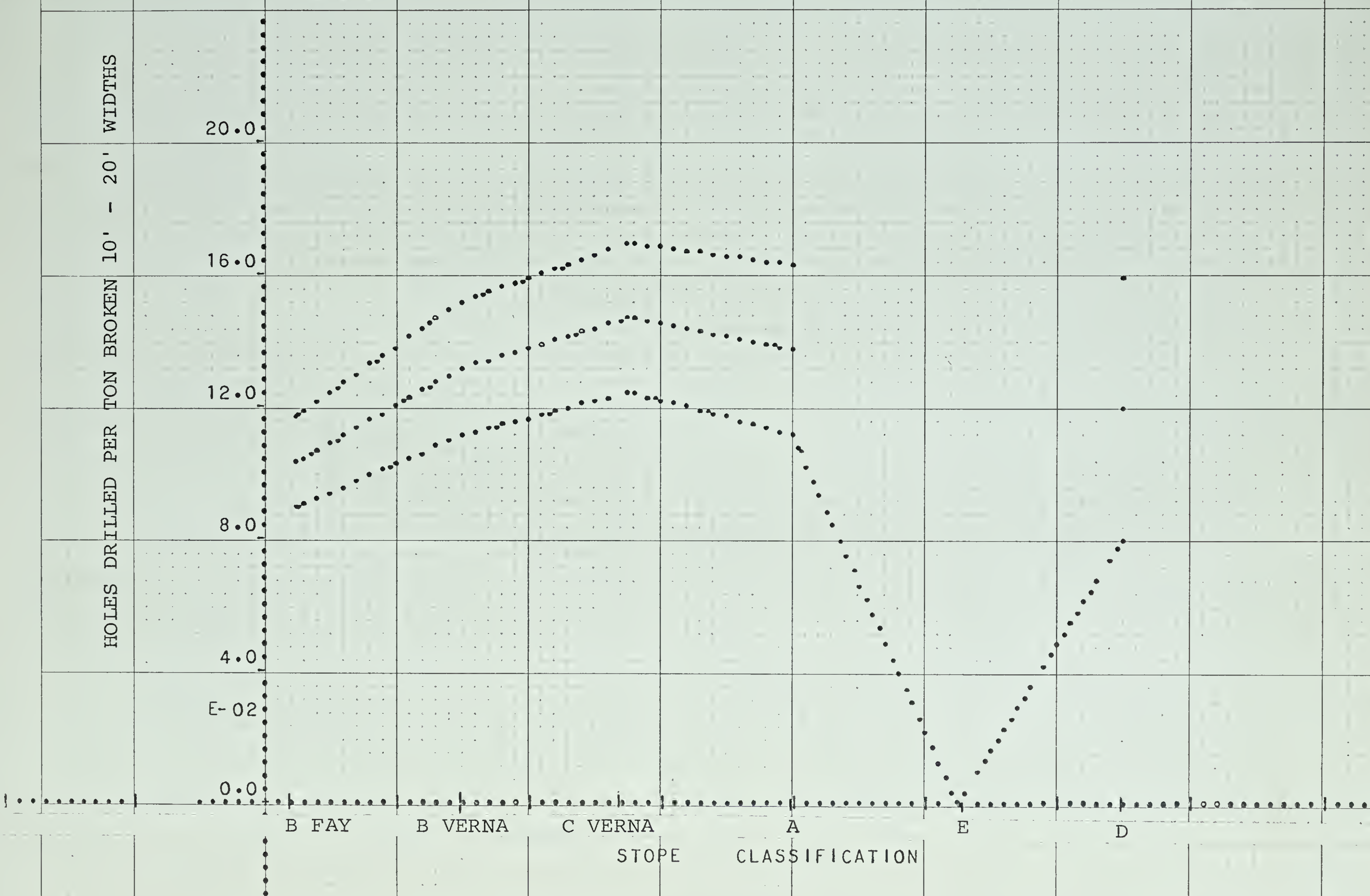

FIG. 58 - HOLES DRILLED PER TON BROKEN - 10' - 20' WIDTHS VS STOPE CLASS

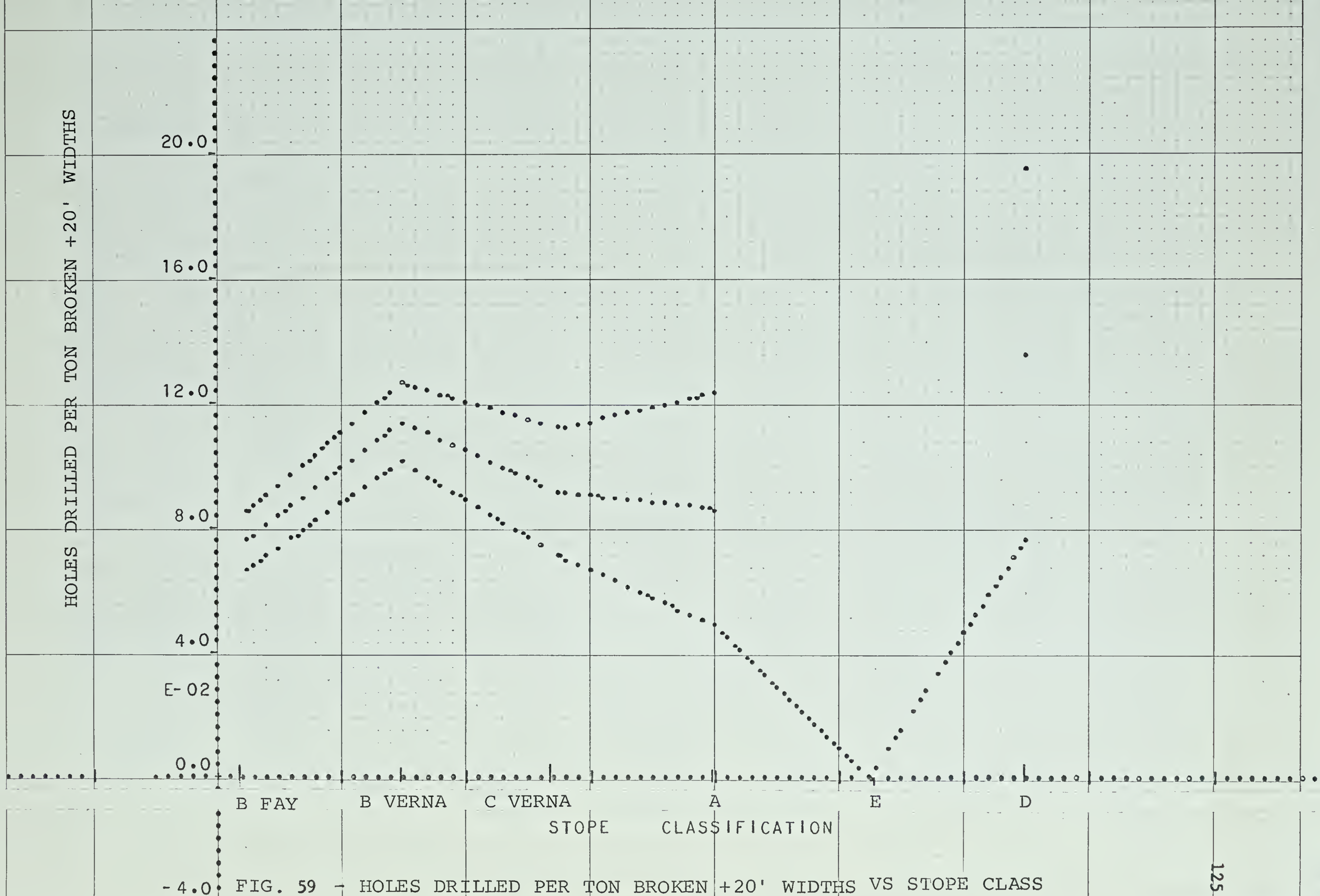

FIG. 59 - HOLES DRILLED PER TON BROKEN +20' WIDTHS VS STOPE CLASS

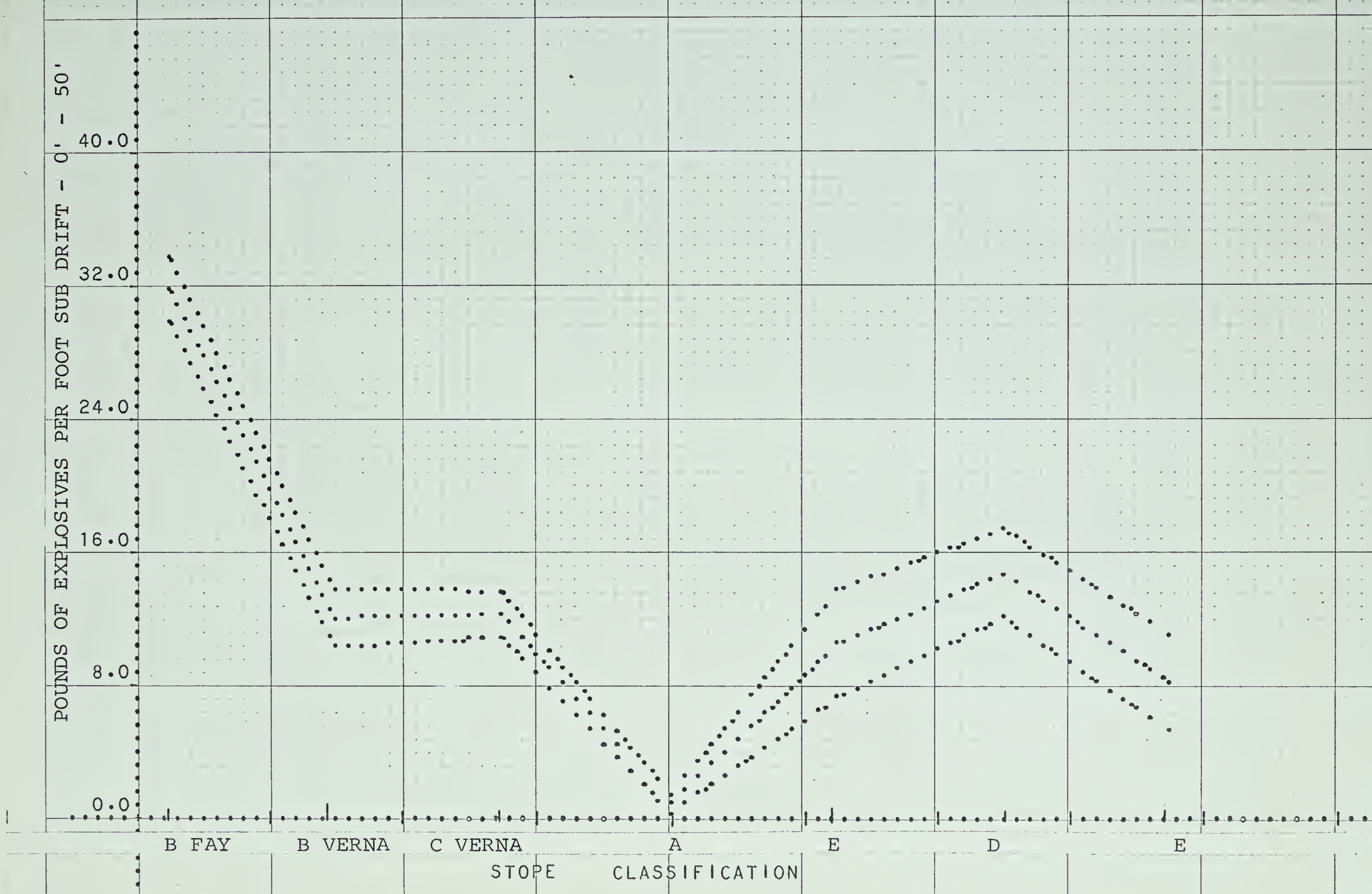

FIG. 60 - POUNDS OF EXPLOSIVE PER FOOT OF SUB DRIFT 0' - 50' FROM MILLHOLE VS STOPE CLASS

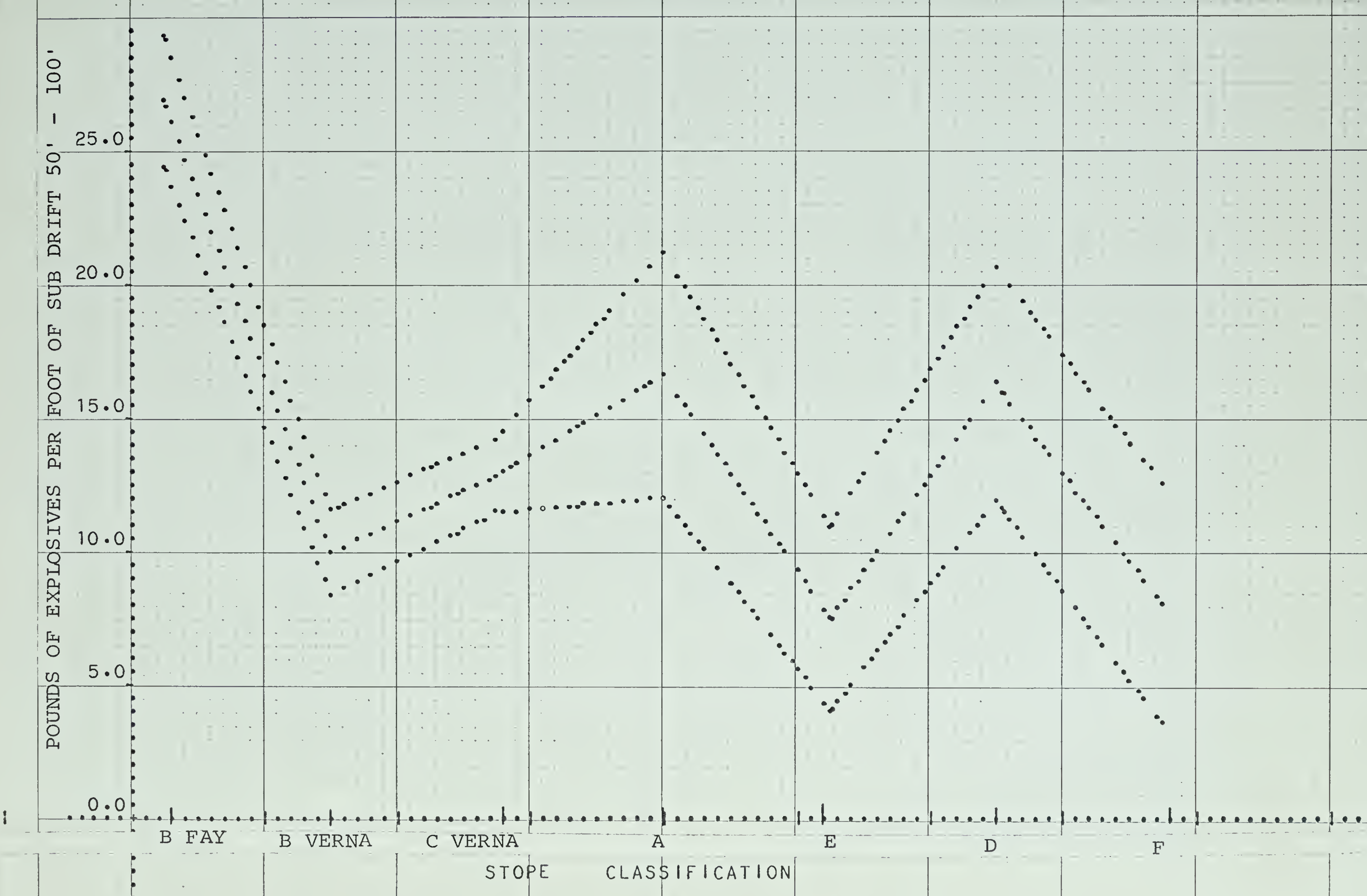

FIG. 61 - POUNDS OF EXPLOSIVE PER FOOT OF SUB DRIFT 50' - 100' VS STOPE CLASS

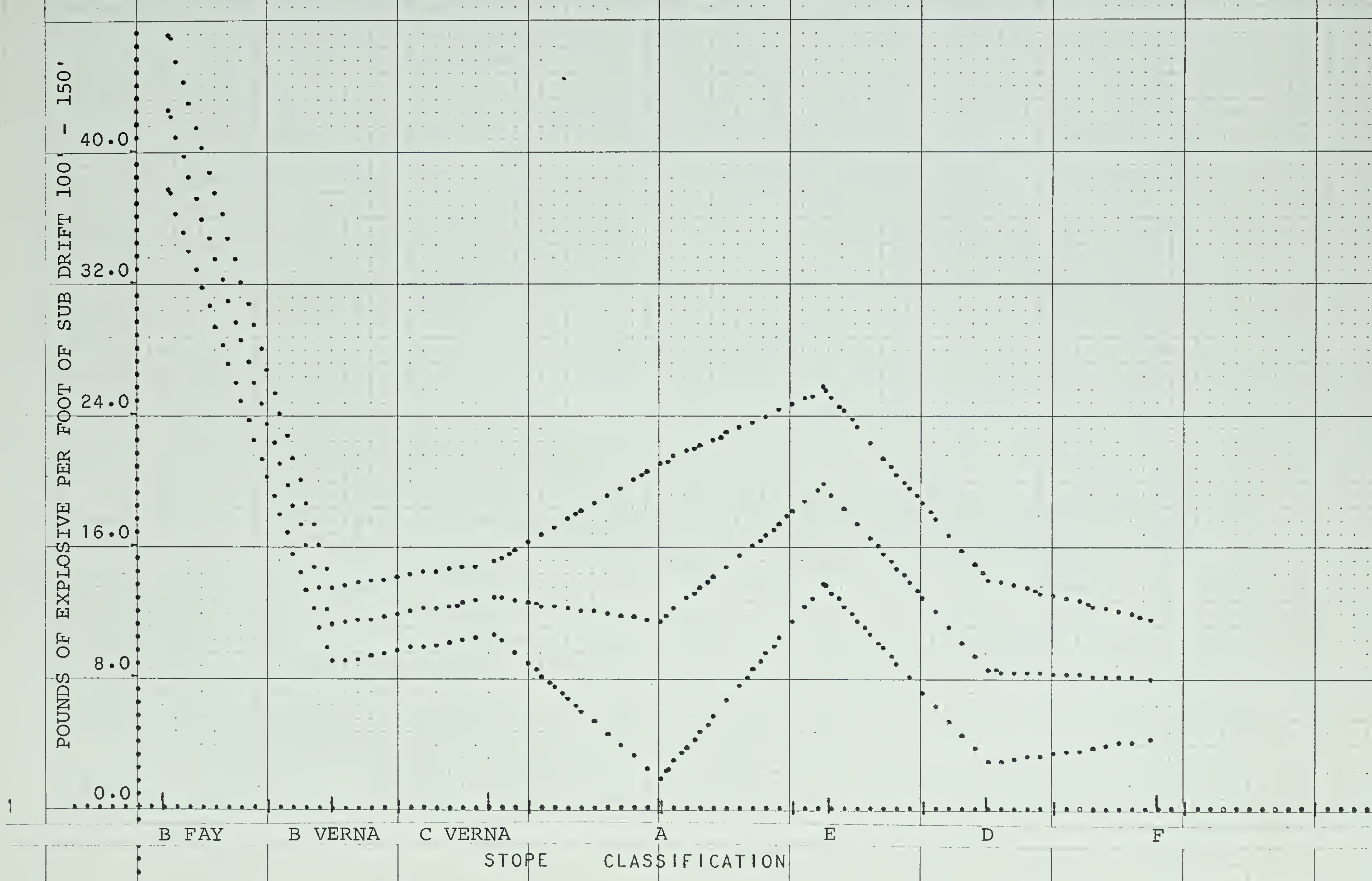

FIG. 62 - POUNDS OF EXPLOSIVE PER FOOT OF SUB DRIFT 100' - 150' VS STOPE CLASS

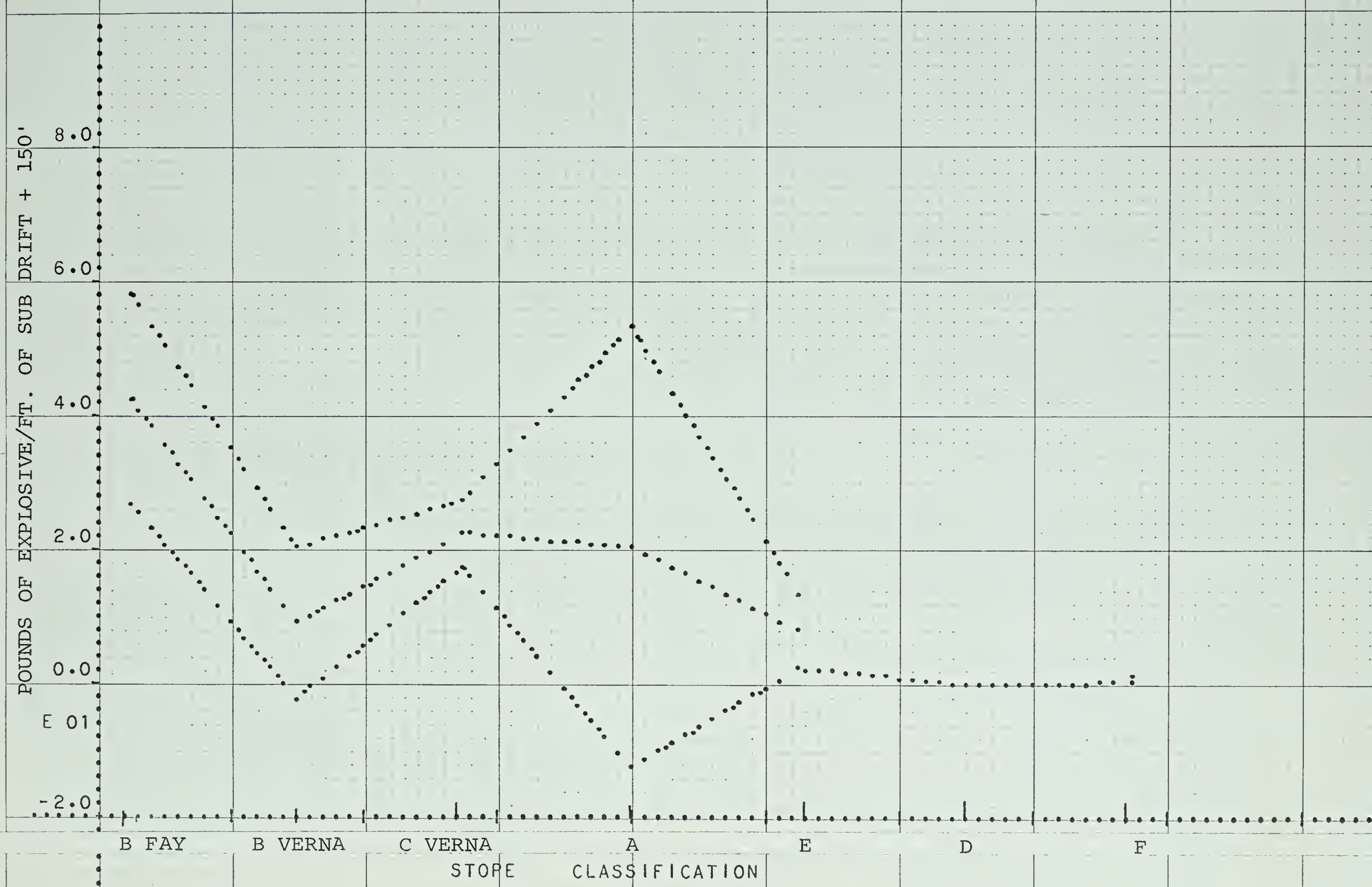

FIG. 63 - POUNDS OF POWDER PER FOOT OF SUB DRIFT + 150' VS STOPE CLASS

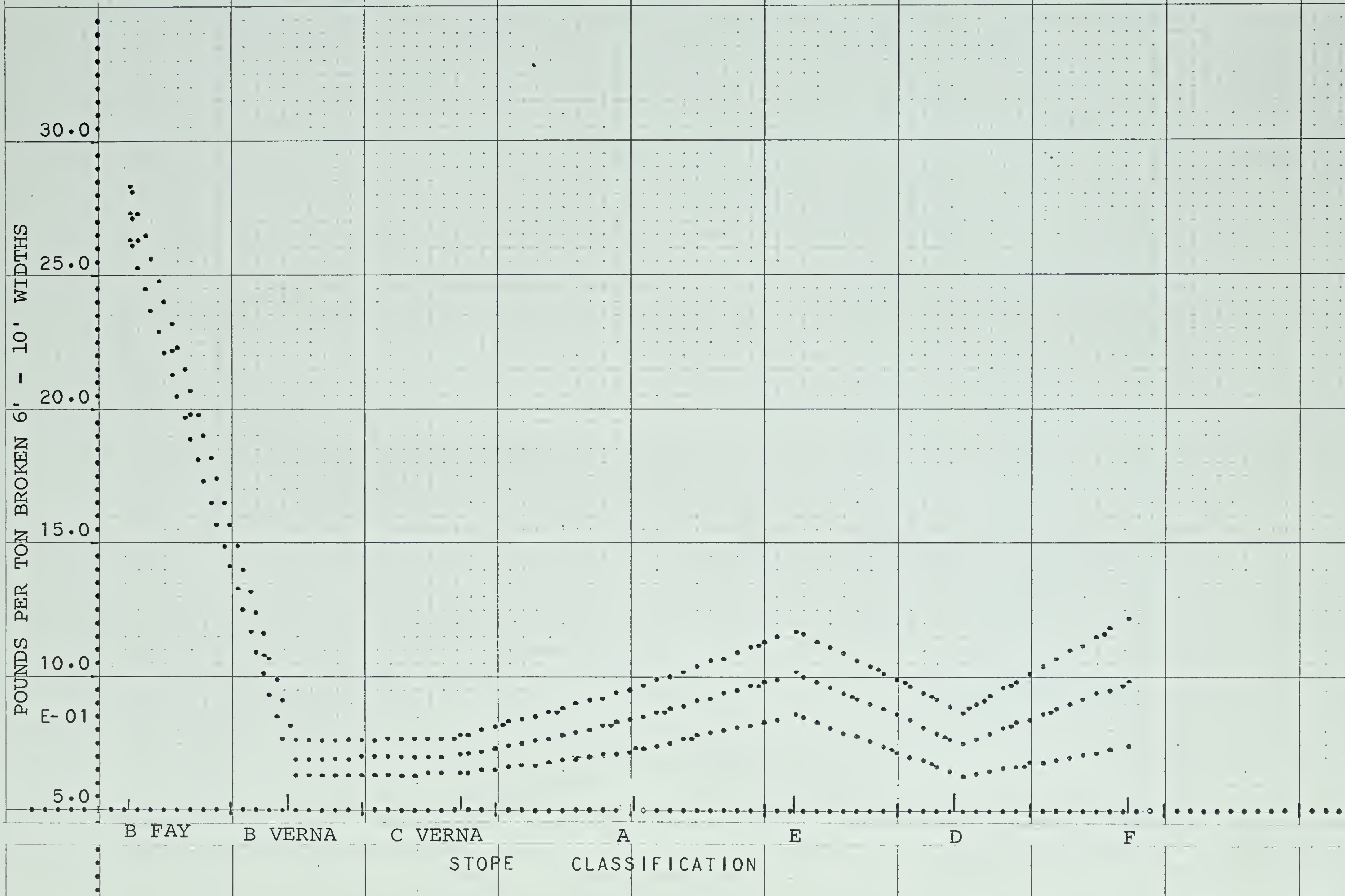

FIG. 64 - POUNDS OF EXPLOSIVE PER TON BROKEN 6' - 10' WIDTHS VS SLOPE CLASS

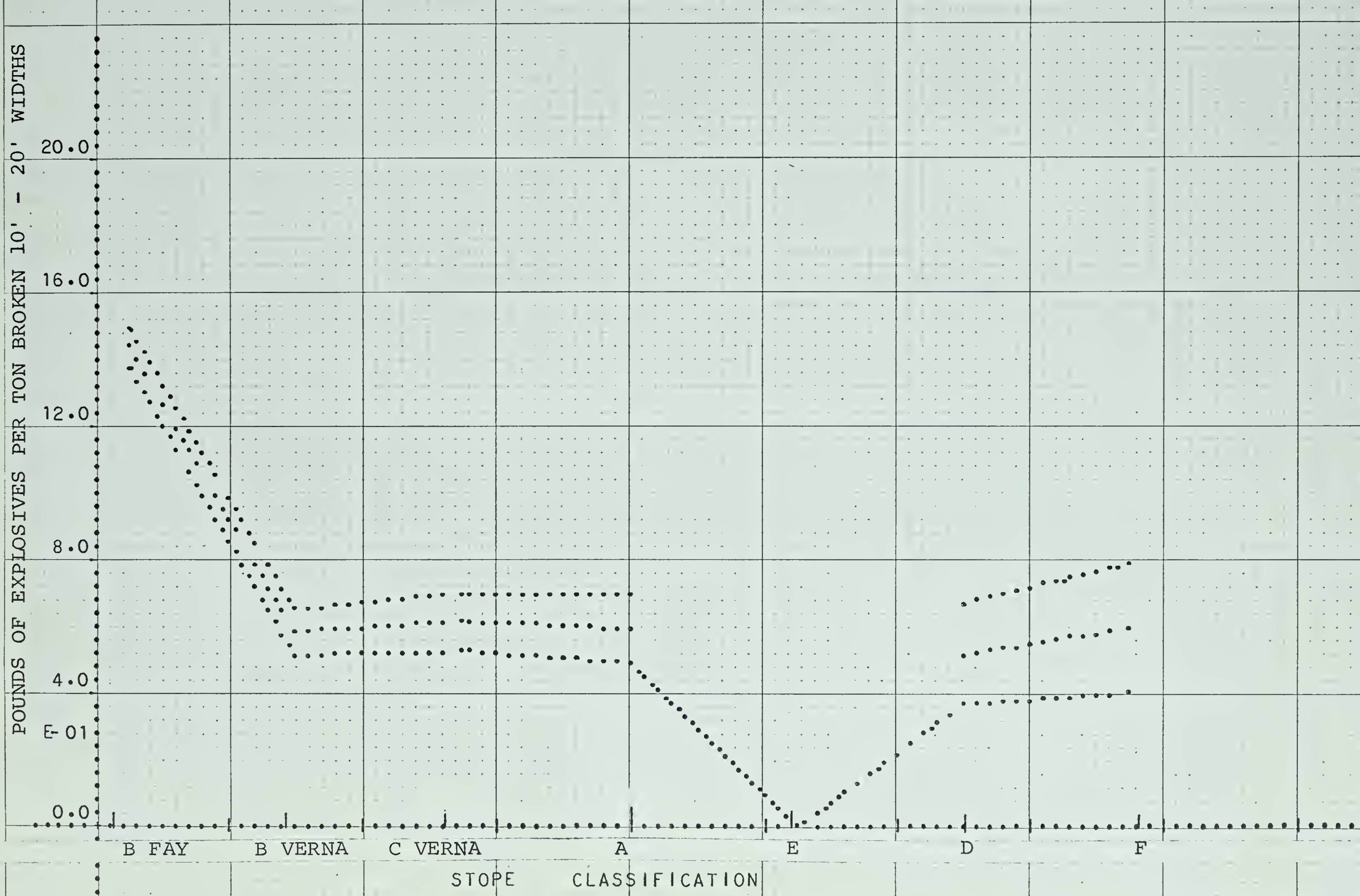

FIG. 65 - POUNDS OF EXPLOSIVE PER TON BROKEN 10' - 20' WIDTHS VS STOPE CLASS

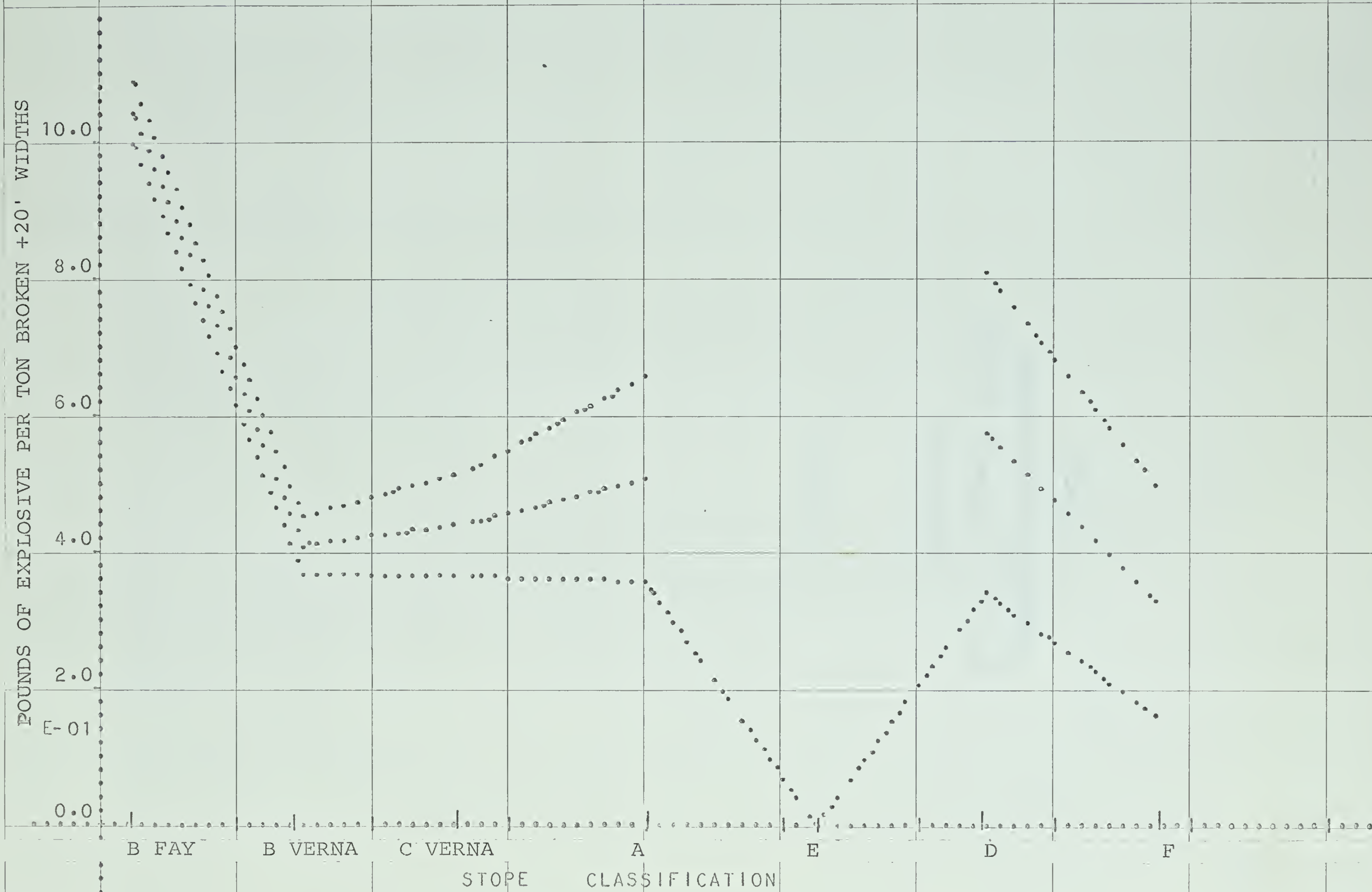

FIG. 66 - POUNDS OF EXPLOSIVE PER TON BROKEN AT +20' WIDTHS VS STOPE CLASS

APPENDIX 1

COMPUTER OUTPUT OF STEPWISE MULTIPLE REGRESSION ON ALL DATA UNDER MODEL I

Program No. 3

MEANS,VARIANCES AND STANDARD DEVIATIONS

3	1	0.56878430E 01	0.32023725E 03	0.17895174E 02
3	2	0.12126666E 02	0.34246257E 03	0.18505744E 02
3	3	0.90207056E 01	0.28038567E 03	0.16744721E 02
3	4	0.31380392E 01	0.12767206E 03	0.11299206E 02
3	5	0.70823529E 00	0.21763707E 02	0.46651588E 01
3	6	0.22429804E 01	0.92218966E 02	0.96030706E 01
3	7	0.25687843E 02	0.83655349E 04	0.91463298E 02
3	8	0.50752863E 03	0.16746036E 06	0.40921921E 03
3	9	0.24626980E 03	0.17908727E 06	0.42318704E 03
3	10	0.22984863E 03	0.32996281E 06	0.57442389E 03
3	11	0.18232157E 02	0.10529533E 05	0.10261351E 03
3	12	0.86277646E 02	0.72277911E 05	0.26884551E 03
3	13	0.89831685E 03	0.69683755E 06	0.83476796E 03
3	14	0.98293332E 02	0.70372479E 05	0.26527812E 03
3	15	0.21281490E 03	0.42443663E 06	0.65148801E 03
3	16	0.35723137E 03	0.11210187E 07	0.10587817E 04
3	17	0.37673712E 01	0.61686474E 02	0.78540737E 01
3	18	0.17996858E 01	0.26213447E 02	0.51199070E 01
3	19	0.81021960E 02	0.41894611E 05	0.20468173E 03
3	20	0.12260078E 03	0.13436107E 06	0.36655296E 03
3	21	0.26125490E 01	0.31703767E 02	0.56306098E 01
3	22	0.10400784E 02	0.14291336E 04	0.37803883E 02
3	23	0.26103529E 02	0.11855544E 04	0.34431881E 02
3	24	0.32015686E 01	0.86168913E 02	0.92827212E 01
3	25	0.16372549E 01	0.68265681E 02	0.82623048E 01
3	26	0.15866666E 02	0.37665379E 04	0.61372126E 02
3	27	0.24325647E 03	0.21380172E 06	0.46238699E 03
3	28	0.81741175E 02	0.79740051E 05	0.28238281E 03
3	29	0.16117647E 00	0.14782675E 02	0.38448244E 01
3	30	0.41785723E 01	0.14276687E 04	0.37784503E 02
3	31	0.14117647E-01	0.25411764E 00	0.50410082E 00
3	32	0.46652782E 01	0.56727660E 03	0.23817569E 02
3	33	0.44642352E 00	0.35777269E 02	0.59814103E 01
3	34	0.40420595E 03	0.35138600E 05	0.18745293E 03
3	35	0.45239215E 01	0.52543332E 01	0.22922332E 01
3	36	0.24162118E 03	0.21569366E 05	0.14686513E 03
3	37	0.71341175E 01	0.50105499E 03	0.22384257E 02
3	38	0.96364705E 03	0.34685015E 06	0.58893985E 03
3	39	0.20267059E 03	0.42180676E 05	0.20537935E 03
3	40	0.79631371E 03	0.28873446E 06	0.53734017E 03
3	41	0.18564377E 01	0.73512475E 00	0.85739416E 00
3	42	0.70110169E 01	0.13512116E 03	0.11624163E 02

REGRESSION COEFFICIENTS AND ANALYSIS OF VARIANCE

3	1			0.26483392E 03			
3	1	1	13	0.15514797E 00	0.45500550E-02	34.10	47.74
3	1						47.74
3	1		1	0.21369441E 08	0.21369441E 08	1162.68	0.00000
3	1		1273	0.23397135E 08	0.18379525E 05		
3	1		1274	0.44766576E 08			
3	1			0.13557111E 03			
3	2			0.26340110E 03			
3	2	1	13	0.13849972E 00	0.43980813E-02	31.49	47.74
3	2	2	1	0.28812699E 01	0.20516019E 00	14.04	7.02
3	2						54.75
3	2		2	0.24510336E 08	0.12255168E 08	769.57	0.00000
3	2		1272	0.20256240E 08	0.15924717E 05		
3	2		1274	0.44766576E 08			
3	2			0.12619317E 03	0.31408950E 07	197.23	
3	2			0.92735117E 00			
3	3			0.22473987E 03			
3	3	1	13	0.12215228E 00	0.43784722E-02	27.90	47.74
3	3	2	1	0.29392938E 01	0.19437479E 00	15.12	7.02
3	3	3	8	0.10445989E 00	0.86175568E-02	12.12	4.69
3	3						59.44
3	3		3	0.26609433E 08	0.88698112E 07	620.89	0.00000
3	3		1271	0.18157142E 08	0.14285714E 05		
3	3		1274	0.44766576E 08			
3	3			0.11952286E 03	0.20990980E 07	146.94	
3	3			0.83617346E 00			
3	4			0.22094911E 03			
3	4	1	13	0.11535977E 00	0.42314100E-02	27.26	47.74
3	4	2	1	0.29428729E 01	0.18582875E 00	15.84	7.02
3	4	3	8	0.10036444E 00	0.82470939E-02	12.17	4.69
3	4	4	20	0.97477219E-01	0.88763970E-02	10.98	3.52
3	4						62.96
3	4		4	0.28184066E 08	0.70460166E 07	539.63	0.00000
3	4		1270	0.16582509E 08	0.13057094E 05		
3	4		1274	0.44766576E 08			
3	4			0.11426764E 03	0.15746327E 07	120.60	
3	4			0.80951808E 00			
3	5			0.20048169E 03			
3	5	1	13	0.13195886E 00	0.43353184E-02	30.44	47.74
3	5	2	1	0.28422597E 01	0.17819495E 00	15.95	7.02
3	5	3	8	0.88721864E-01	0.79710955E-02	11.13	4.69
3	5	4	20	0.10258152E 00	0.85132546E-02	12.05	3.52
3	5	5	12	0.13226603E 00	0.12283181E-01	10.77	3.10
3	5						66.06
3	5		5	0.29572390E 08	0.59144779E 07	493.97	0.00000
3	5		1269	0.15194186E 08	0.11973353E 05		
3	5		1274	0.44766576E 08			
3	5			0.10942282E 03	0.13883237E 07	115.95	
3	5			0.69766289E 00			

3	6			0.18076888E 03			
3	6	1	13	0.13816832E 00	0.42460946E-02	32.54	47.74
3	6	2	1	0.26611105E 01	0.17347061E 00	15.34	7.02
3	6	3	8	0.79494296E-01	0.77740373E-02	10.23	4.69
3	6	4	20	0.10948958E 00	0.82688719E-02	13.24	3.52
3	6	5	12	0.13630333E 00	0.11890912E-01	11.46	3.10
3	6	6	2	0.15381870E 01	0.16407797E 00	9.37	2.20
3	6						68.26
3	6		6	0.30557245E 08	0.50928741E 07	454.47	0.00000
3	6		1268	0.14209331E 08	0.11206097E 05		
3	6		1274	0.44766576E 08			
3	6			0.10585885E 03	0.98485449E 06	87.89	
3	6			0.66560549E 00			
3	7			0.17635963E 03			
3	7	1	13	0.13207544E 00	0.41823076E-02	31.58	47.74
3	7	2	1	0.25046565E 01	0.16943438E 00	14.78	7.02
3	7	3	8	0.84200822E-01	0.75700256E-02	11.12	4.69
3	7	4	20	0.10003805E 00	0.81035321E-02	12.34	3.52
3	7	5	12	0.13743292E 00	0.11550484E-01	11.90	3.10
3	7	6	2	0.15816927E 01	0.15944773E 00	9.92	2.20
3	7	7	16	0.24962845E-01	0.28445582E-02	8.78	1.82
3	7						70.08
3	7		7	0.31371441E 08	0.44816343E 07	423.90	0.00000
3	7		1267	0.13395135E 08	0.10572325E 05		
3	7		1274	0.44766576E 08			
3	7			0.10282181E 03	0.81419599E 06	77.01	
3	7			0.60894128E 00			
3	8			0.16774834E 03			
3	8	1	13	0.13004244E 00	0.40867855E-02	31.82	47.74
3	8	2	1	0.22517905E 01	0.16816272E 00	13.39	7.02
3	8	3	8	0.91773612E-01	0.74419127E-02	12.33	4.69
3	8	4	20	0.80941306E-01	0.82461323E-02	9.82	3.52
3	8	5	12	0.14236058E 00	0.11281808E-01	12.62	3.10
3	8	6	2	0.15965994E 01	0.15552413E 00	10.27	2.20
3	8	7	16	0.29690715E-01	0.28348197E-02	10.47	1.82
3	8	8	15	0.37961788E-01	0.46755944E-02	8.12	1.48
3	8						71.56
3	8		8	0.32034402E 08	0.40043003E 07	398.16	0.00000
3	8		1266	0.12732173E 08	0.10057009E 05		
3	8		1274	0.44766576E 08			
3	8			0.10028464E 03	0.66296174E 06	65.92	
3	8			0.51806981E 00			

3	9			0.15828145E 03			
3	9	1	13	0.13180383E 00	0.40018955E-02	32.94	47.74
3	9	2	1	0.22632891E 01	0.16440853E 00	13.77	7.02
3	9	3	8	0.80554770E-01	0.74192197E-02	10.86	4.69
3	9	4	20	0.85031304E-01	0.80791014E-02	10.52	3.52
3	9	5	12	0.14585823E 00	0.11038794E-01	13.21	3.10
3	9	6	2	0.16509854E 01	0.15220900E 00	10.85	2.20
3	9	7	16	0.30010040E-01	0.27717279E-02	10.83	1.82
3	9	8	15	0.39071050E-01	0.45732835E-02	8.54	1.48
3	9	9	3	0.12970404E 01	0.16802801E 00	7.72	1.28
3	9						72.84
3	9		9	0.32607153E 08	0.36230170E 07	376.92	0.00000
3	9		1265	0.12159422E 08	0.96121913E 04		
3	9		1274	0.44766576E 08			
3	9			0.98041784E 02	0.57275125E 06	59.59	
3	9			0.49376702E 00			
3	10			0.15232350E 03			
3	10	1	13	0.12059339E 00	0.42208635E-02	28.57	47.74
3	10	2	1	0.23165488E 01	0.16136527E 00	14.36	7.02
3	10	3	8	0.89334326E-01	0.73755742E-02	12.11	4.69
3	10	4	20	0.81922983E-01	0.79329685E-02	10.33	3.52
3	10	5	12	0.13933398E 00	0.10860896E-01	12.83	3.10
3	10	6	2	0.17040846E 01	0.14941659E 00	11.40	2.20
3	10	7	16	0.28526147E-01	0.27253581E-02	10.47	1.82
3	10	8	15	0.36543011E-01	0.44976232E-02	8.12	1.48
3	10	9	3	0.13037682E 01	0.16474731E 00	7.91	1.28
3	10	10	9	0.51070582E-01	0.70873220E-02	7.21	1.07
3	10						73.91
3	10		10	0.33086952E 08	0.33086952E 07	358.08	0.00000
3	10		1264	0.11679624E 08	0.92402085E 04		
3	10		1274	0.44766576E 08			
3	10			0.96126003E 02	0.47979850E 06	51.93	
3	10			0.39811208E 00			
3	11			0.15039749E 03			
3	11	1	13	0.97801385E-01	0.51182473E-02	19.11	47.74
3	11	2	1	0.22192044E 01	0.15843994E 00	14.01	7.02
3	11	3	8	0.10892380E 00	0.76710243E-02	14.20	4.69
3	11	4	20	0.84549147E-01	0.77710670E-02	10.88	3.52
3	11	5	12	0.12506178E 00	0.10795742E-01	11.58	3.10
3	11	6	2	0.16730848E 01	0.14627792E 00	11.44	2.20
3	11	7	16	0.27180920E-01	0.26730142E-02	10.17	1.82
3	11	8	15	0.37770453E-01	0.44044150E-02	8.58	1.48
3	11	9	3	0.13233793E 01	0.16124387E 00	8.21	1.28
3	11	10	9	0.67493507E-01	0.72695825E-02	9.28	1.07
3	11	11	10	0.44791187E-01	0.59396546E-02	7.54	1.12
3	11						75.03
3	11		11	0.33590176E 08	0.30536523E 07	345.08	0.00000
3	11		1263	0.11176400E 08	0.88490892E 04		
3	11		1274	0.44766576E 08			
3	11			0.94069598E 02	0.50322375E 06	56.87	
3	11			0.23754567E 00			

3	12			0.14276961E 03			
3	12	1	13	0.91561695E-01	0.50199506E-02	18.24	47.74
3	12	2	1	0.21585216E 01	0.15399673E 00	14.02	7.02
3	12	3	8	0.11829198E 00	0.75239636E-02	15.72	4.69
3	12	4	20	0.77403743E-01	0.75890454E-02	10.20	3.52
3	12	5	12	0.11885720E 00	0.10506122E-01	11.31	3.10
3	12	6	2	0.16182637E 01	0.14216973E 00	11.38	2.20
3	12	7	16	0.28562497E-01	0.26001868E-02	10.98	1.82
3	12	8	15	0.36763477E-01	0.42781426E-02	8.59	1.48
3	12	9	3	0.13095080E 01	0.15657310E 00	8.36	1.28
3	12	10	9	0.76993184E-01	0.71405342E-02	10.78	1.07
3	12	11	10	0.52932186E-01	0.58408704E-02	9.06	1.12
3	12	12	7	0.25440000E 00	0.28876809E-01	8.81	1.45
3	12						76.48
3	12		12	0.34237703E 08	0.28531419E 07	341.98	0.00000
3	12		1262	0.10528872E 08	0.83430051E 04		
3	12		1274	0.44766576E 08			
3	12			0.91340052E 02	0.64752749E 06	77.61	
3	12			0.22300164E 00			
3	13			0.13710390E 03			
3	13	1	13	0.86071031E-01	0.49665212E-02	17.33	47.74
3	13	2	1	0.20787454E 01	0.15107863E 00	13.76	7.02
3	13	3	8	0.12547833E 00	0.74248095E-02	16.90	4.69
3	13	4	20	0.73085989E-01	0.74490132E-02	9.81	3.52
3	13	5	12	0.11774630E 00	0.10282725E-01	11.45	3.10
3	13	6	2	0.16709758E 01	0.13930837E 00	11.99	2.20
3	13	7	16	0.22971633E-01	0.26507423E-02	8.67	1.82
3	13	8	15	0.30935253E-01	0.42576854E-02	7.27	1.48
3	13	9	3	0.13569479E 01	0.15335749E 00	8.85	1.28
3	13	10	9	0.81861604E-01	0.70178270E-02	11.66	1.07
3	13	11	10	0.55558449E-01	0.57267150E-02	9.70	1.12
3	13	12	7	0.25721570E 00	0.28262351E-01	9.10	1.45
3	13	13	19	0.10275283E 00	0.13645660E-01	7.53	1.01
3	13						77.49
3	13		13	0.34690771E 08	0.26685208E 07	333.97	0.00000
3	13		1261	0.10075805E 08	0.79903290E 04		
3	13		1274	0.44766576E 08			
3	13			0.89388640E 02	0.45306750E 06	56.70	
3	13			0.17928998E 00			

3	14			0.13098009E 03			
3	14	1	13	0.88701065E-01	0.48715075E-02	18.21	47.74
3	14	2	1	0.20606995E 01	0.14783061E 00	13.94	7.02
3	14	3	8	0.11845499E 00	0.73231899E-02	16.18	4.69
3	14	4	20	0.74094455E-01	0.72891370E-02	10.17	3.52
3	14	5	12	0.11975145E 00	0.10063834E-01	11.90	3.10
3	14	6	2	0.18203867E 01	0.13771595E 00	13.22	2.20
3	14	7	16	0.22513914E-01	0.25941213E-02	8.68	1.82
3	14	8	15	0.32231999E-01	0.41691257E-02	7.73	1.48
3	14	9	3	0.12948485E 01	0.15026485E 00	8.62	1.28
3	14	10	9	0.83982108E-01	0.68717654E-02	12.22	1.07
3	14	11	10	0.54783974E-01	0.56038020E-02	9.78	1.12
3	14	12	7	0.25977923E 00	0.27653221E-01	9.39	1.45
3	14	13	19	0.10355418E 00	0.13350978E-01	7.76	1.01
3	14	14	4	0.16866073E 01	0.22268965E 00	7.57	0.98
3	14						78.47
3	14		14	0.35129506E 08	0.25092504E 07	328.07	0.00000
3	14		1260	0.96370699E 07	0.76484681E 04		
3	14		1274	0.44766576E 08			
3	14			0.87455521E 02	0.43873500E 06	57.36	
3	14			0.17000634E 00			
3	15			0.12682268E 03			
3	15	1	13	0.87545166E-01	0.47874039E-02	18.29	47.74
3	15	2	1	0.20607848E 01	0.14518879E 00	14.19	7.02
3	15	3	8	0.11370283E 00	0.72254561E-02	15.74	4.69
3	15	4	20	0.75980169E-01	0.71641281E-02	10.61	3.52
3	15	5	12	0.11448912E 00	0.99135778E-02	11.55	3.10
3	15	6	2	0.18501329E 01	0.13532407E 00	13.67	2.20
3	15	7	16	0.23205807E-01	0.25497497E-02	9.10	1.82
3	15	8	15	0.33470647E-01	0.40985826E-02	8.17	1.48
3	15	9	3	0.13363468E 01	0.14770291E 00	9.05	1.28
3	15	10	9	0.84336237E-01	0.67491597E-02	12.50	1.07
3	15	11	10	0.57768571E-01	0.55207522E-02	10.46	1.12
3	15	12	7	0.25734822E 00	0.27161344E-01	9.47	1.45
3	15	13	19	0.10449027E 00	0.13113095E-01	7.97	1.01
3	15	14	4	0.15235056E 01	0.21999285E 00	6.93	0.98
3	15	15	14	0.64189006E-01	0.93361067E-02	6.88	0.78
3	15						79.25
3	15		15	0.35478245E 08	0.23652163E 07	320.60	0.00000
3	15		1259	0.92883304E 07	0.73775459E 04		
3	15		1274	0.44766576E 08			
3	15			0.85892641E 02	0.34873950E 06	47.27	
3	15			0.16049929E 00			

3	16			0.12090617E 03			
3	16	1	13	0.86324097E-01	0.47066521E-02	18.34	47.74
3	16	2	1	0.20818401E 01	0.14266983E 00	14.59	7.02
3	16	3	8	0.11444043E 00	0.70992580E-02	16.12	4.69
3	16	4	20	0.68125267E-01	0.71318998E-02	9.55	3.52
3	16	5	12	0.11690218E 00	0.97457299E-02	12.00	3.10
3	16	6	2	0.18731935E 01	0.13298812E 00	14.09	2.20
3	16	7	16	0.22816936E-01	0.25055748E-02	9.11	1.82
3	16	8	15	0.28659949E-01	0.40879151E-02	7.01	1.48
3	16	9	3	0.13942657E 01	0.14535488E 00	9.59	1.28
3	16	10	9	0.85414126E-01	0.66323955E-02	12.88	1.07
3	16	11	10	0.61382596E-01	0.54495520E-02	11.26	1.12
3	16	12	7	0.25097648E 00	0.26700218E-01	9.40	1.45
3	16	13	19	0.10966219E 00	0.12904894E-01	8.50	1.01
3	16	14	4	0.15552087E 01	0.21617544E 00	7.19	0.98
3	16	15	14	0.66235863E-01	0.91768931E-02	7.22	0.78
3	16	16	18	0.33242142E 01	0.48768833E 00	6.82	0.74
3	16						79.99
3	16		16	0.35809071E 08	0.22380670E 07	314.32	0.00000
3	16		1258	0.89575044E 07	0.71204327E 04		
3	16		1274	0.44766576E 08			
3	16			0.84382656E 02	0.33082600E 06	46.46	
3	16			0.14388026E 00			
3	17			0.11327920E 03			
3	17	1	13	0.81647071E-01	0.46435690E-02	17.58	47.74
3	17	2	1	0.20776340E 01	0.13952869E 00	14.89	7.02
3	17	3	8	0.12238508E 00	0.70204352E-02	17.43	4.69
3	17	4	20	0.53824376E-01	0.72219234E-02	7.45	3.52
3	17	5	12	0.11786326E 00	0.95319165E-02	12.37	3.10
3	17	6	2	0.18795547E 01	0.13006180E 00	14.45	2.20
3	17	7	16	0.15468889E-01	0.26325958E-02	5.88	1.82
3	17	8	15	0.23315129E-01	0.40587015E-02	5.74	1.48
3	17	9	3	0.14103687E 01	0.14216916E 00	9.92	1.28
3	17	10	9	0.88548871E-01	0.64993007E-02	13.62	1.07
3	17	11	10	0.66578552E-01	0.53727987E-02	12.39	1.12
3	17	12	7	0.25673524E 00	0.26123051E-01	9.83	1.45
3	17	13	19	0.97161716E-01	0.12726416E-01	7.63	1.01
3	17	14	4	0.16553393E 01	0.21182063E 00	7.81	0.98
3	17	15	14	0.69767841E-01	0.89866902E-02	7.76	0.78
3	17	16	18	0.37390506E 01	0.48003177E 00	7.79	0.74
3	17	17	17	0.27927293E 01	0.36576020E 00	7.64	0.89
3	17						80.88
3	17		17	0.36206105E 08	0.21297709E 07	312.73	0.00000
3	17		1257	0.85604709E 07	0.68102394E 04		
3	17		1274	0.44766576E 08			
3	17			0.82524174E 02	0.39703350E 06	58.30	
3	17			0.93199010E-01			

3	18			0.10564328E 03			
3	18	1	13	0.88899685E-01	0.46547898E-02	19.10	47.74
3	18	2	1	0.20495768E 01	0.13673448E 00	14.99	7.02
3	18	3	8	0.11790861E 00	0.69041230E-02	17.08	4.69
3	18	4	20	0.54322618E-01	0.70748586E-02	7.68	3.52
3	18	5	12	0.12892474E 00	0.94581097E-02	13.63	3.10
3	18	6	2	0.18653619E 01	0.12742206E 00	14.64	2.20
3	18	7	16	0.15802501E-01	0.25792681E-02	6.13	1.82
3	18	8	15	0.24186852E-01	0.39776405E-02	6.08	1.48
3	18	9	3	0.14457834E 01	0.13935115E 00	10.38	1.28
3	18	10	9	0.85515797E-01	0.63800427E-02	13.40	1.07
3	18	11	10	0.63253090E-01	0.52825940E-02	11.97	1.12
3	18	12	7	0.24766489E 00	0.25619707E-01	9.67	1.45
3	18	13	19	0.97232609E-01	0.12466690E-01	7.80	1.01
3	18	14	4	0.16245938E 01	0.20753988E 00	7.83	0.98
3	18	15	14	0.72975078E-01	0.88141114E-02	8.28	0.78
3	18	16	18	0.38854390E 01	0.47065732E 00	8.26	0.74
3	18	17	17	0.28641098E 01	0.35842734E 00	7.99	0.89
3	18	18	11	0.16850573E 00	0.22947281E-01	7.34	0.79
3	18						81.66
3	18		18	0.36558491E 08	0.20310273E 07	310.79	0.00000
3	18		1256	0.82080849E 07	0.65350994E 04		
3	18		1274	0.44766576E 08			
3	18			0.80839961E 02	0.35238600E 06	53.92	
3	18			0.86222870E-01			
3	19			0.10225580E 03			
3	19	1	13	0.90236534E-01	0.45770500E-02	19.71	47.74
3	19	2	1	0.20522176E 01	0.13432783E 00	15.28	7.02
3	19	3	8	0.11649390E 00	0.67857537E-02	17.17	4.69
3	19	4	20	0.55088578E-01	0.69512149E-02	7.93	3.52
3	19	5	12	0.98574554E-01	0.10304244E-01	9.57	3.10
3	19	6	2	0.18069539E 01	0.12547201E 00	14.40	2.20
3	19	7	16	0.16135583E-01	0.25343316E-02	6.37	1.82
3	19	8	15	0.25009578E-01	0.39094796E-02	6.40	1.48
3	19	9	3	0.15095186E 01	0.13721712E 00	11.00	1.28
3	19	10	9	0.84661615E-01	0.62689759E-02	13.50	1.07
3	19	11	10	0.62925737E-01	0.51898164E-02	12.12	1.12
3	19	12	7	0.22768670E 00	0.25338909E-01	8.99	1.45
3	19	13	19	0.97901922E-01	0.12247608E-01	7.99	1.01
3	19	14	4	0.16241216E 01	0.20388615E 00	7.97	0.98
3	19	15	14	0.76234988E-01	0.86721486E-02	8.79	0.78
3	19	16	18	0.40654086E 01	0.46312532E 00	8.78	0.74
3	19	17	17	0.29404065E 01	0.35229526E 00	8.35	0.89
3	19	18	11	0.16399564E 00	0.22553011E-01	7.27	0.79
3	19	19	28	0.63003548E-01	0.92472849E-02	6.81	0.65
3	19						82.32
3	19		19	0.36851260E 08	0.19395400E 07	307.52	0.00000
3	19		1255	0.79153154E 07	0.63070243E 04		
3	19		1274	0.44766576E 08			
3	19			0.79416775E 02	0.29276950E 06	46.42	
3	19			0.62599742E-01			

3	20			0.98943066E 02			
3	20	1	13	0.90720119E-01	0.44948370E-02	20.18	47.74
3	20	2	1	0.20451864E 01	0.13190294E 00	15.51	7.02
3	20	3	8	0.11877235E 00	0.66712297E-02	17.80	4.69
3	20	4	20	0.53710423E-01	0.68284475E-02	7.87	3.52
3	20	5	12	0.98847647E-01	0.10118008E-01	9.77	3.10
3	20	6	2	0.17291930E 01	0.12371729E 00	13.98	2.20
3	20	7	16	0.15800806E-01	0.24889802E-02	6.35	1.82
3	20	8	15	0.24601988E-01	0.38392453E-02	6.41	1.48
3	20	9	3	0.15362103E 01	0.13479153E 00	11.40	1.28
3	20	10	9	0.84350215E-01	0.61557899E-02	13.70	1.07
3	20	11	10	0.63599969E-01	0.50969139E-02	12.48	1.12
3	20	12	7	0.19519208E 00	0.25322190E-01	7.71	1.45
3	20	13	19	0.96443901E-01	0.12028010E-01	8.02	1.01
3	20	14	4	0.16285077E 01	0.20020064E 00	8.13	0.98
3	20	15	14	0.73424269E-01	0.85250753E-02	8.61	0.78
3	20	16	18	0.40659021E 01	0.45475142E 00	8.94	0.74
3	20	17	17	0.30448690E 01	0.34625619E 00	8.79	0.89
3	20	18	11	0.16123138E 00	0.22148844E-01	7.28	0.79
3	20	19	28	0.62685525E-01	0.90801989E-02	6.90	0.65
3	20	20	6	0.16205723E 01	0.23477841E 00	6.90	0.65
3	20						82.97
3	20		20	0.37140992E 08	0.18570496E 07	305.39	0.00000
3	20		1254	0.76255839E 07	0.60810079E 04		
3	20		1274	0.44766576E 08			
3	20			0.77980817E 02	0.28973150E 06	47.65	
3	20			0.58781696E-01			
3	21			0.97746911E 02			
3	21	1	13	0.84591940E-01	0.46150939E-02	18.33	47.74
3	21	2	1	0.19791211E 01	0.13129685E 00	15.07	7.02
3	21	3	8	0.12052234E 00	0.66164804E-02	18.22	4.69
3	21	4	20	0.51637919E-01	0.67755704E-02	7.62	3.52
3	21	5	12	0.90123628E-01	0.10169735E-01	8.86	3.10
3	21	6	2	0.17051133E 01	0.12262589E 00	13.91	2.20
3	21	7	16	0.15620620E-01	0.24654069E-02	6.34	1.82
3	21	8	15	0.25339830E-01	0.38053041E-02	6.66	1.48
3	21	9	3	0.15454098E 01	0.13351335E 00	11.57	1.28
3	21	10	9	0.84946589E-01	0.60979957E-02	13.93	1.07
3	21	11	10	0.66063815E-01	0.50717586E-02	13.03	1.12
3	21	12	7	0.20436043E 00	0.25145703E-01	8.13	1.45
3	21	13	19	0.10030212E 00	0.11937444E-01	8.40	1.01
3	21	14	4	0.16312027E 01	0.19828435E 00	8.23	0.98
3	21	15	14	0.67892547E-01	0.85145849E-02	7.97	0.78
3	21	16	18	0.41161926E 01	0.45050767E 00	9.14	0.74
3	21	17	17	0.30607302E 01	0.34295511E 00	8.92	0.89
3	21	18	11	0.14605331E 00	0.22142808E-01	6.60	0.79
3	21	19	28	0.68444539E-01	0.90656588E-02	7.55	0.65
3	21	20	6	0.16019185E 01	0.23255981E 00	6.89	0.65
3	21	21	27	0.25830674E-01	0.51288767E-02	5.04	0.34
3	21						83.30
3	21		21	0.37292294E 08	0.17758235E 07	297.70	0.00000
3	21		1253	0.74742819E 07	0.59651092E 04		
3	21		1274	0.44766576E 08			
3	21			0.77234119E 02	0.15130200E 06	25.36	
3	21			0.48936775E-01			

3	22			0.97841442E 02			
3	22	1	13	0.84611993E-01	0.45760364E-02	18.49	47.74
3	22	2	1	0.19832572E 01	0.13018856E 00	15.23	7.02
3	22	3	8	0.11759470E 00	0.65894748E-02	17.85	4.69
3	22	4	20	0.53254053E-01	0.67268669E-02	7.92	3.52
3	22	5	12	0.87681619E-01	0.10096808E-01	8.68	3.10
3	22	6	2	0.17531825E 01	0.12200998E 00	14.37	2.20
3	22	7	16	0.15784511E-01	0.24447855E-02	6.46	1.82
3	22	8	15	0.25029302E-01	0.37736666E-02	6.63	1.48
3	22	9	3	0.15984752E 01	0.13285560E 00	12.03	1.28
3	22	10	9	0.85879386E-01	0.60495855E-02	14.20	1.07
3	22	11	10	0.66221742E-01	0.50289445E-02	13.17	1.12
3	22	12	7	0.19365160E 00	0.25034970E-01	7.74	1.45
3	22	13	19	0.10183114E 00	0.11840804E-01	8.60	1.01
3	22	14	4	0.16180260E 01	0.19662583E 00	8.23	0.98
3	22	15	14	0.55975169E-01	0.88087171E-02	6.35	0.78
3	22	16	18	0.40944069E 01	0.44671847E 00	9.17	0.74
3	22	17	17	0.30391176E 01	0.34008309E 00	8.94	0.89
3	22	18	11	0.14239005E 00	0.21968994E-01	6.48	0.79
3	22	19	28	0.70406021E-01	0.89984466E-02	7.82	0.65
3	22	20	6	0.16067385E 01	0.23059380E 00	6.97	0.65
3	22	21	27	0.24839368E-01	0.50897647E-02	4.88	0.34
3	22	22	5	0.23489746E 01	0.49540872E 00	4.74	0.29
3	22						83.60
3	22		22	0.37424139E 08	0.17010972E 07	290.06	0.00000
3	22		1252	0.73424369E 07	0.58645663E 04		
3	22		1274	0.44766576E 08			
3	22			0.76580455E 02	0.13184500E 06	22.48	
3	22			0.42173693E-01			

3	23			0.97864877E 02			
3	23	1	13	0.83975513E-01	0.45560628E-02	18.43	47.74
3	23	2	1	0.19971162E 01	0.12958231E 00	15.41	7.02
3	23	3	8	0.11898372E 00	0.65667298E-02	18.12	4.69
3	23	4	20	0.54292154E-01	0.66985999E-02	8.11	3.52
3	23	5	12	0.85017929E-01	0.10071196E-01	8.44	3.10
3	23	6	2	0.17356156E 01	0.12148357E 00	14.29	2.20
3	23	7	16	0.15427482E-01	0.24342907E-02	6.34	1.82
3	23	8	15	0.24903325E-01	0.37546891E-02	6.63	1.48
3	23	9	3	0.15923736E 01	0.13219230E 00	12.05	1.28
3	23	10	9	0.86605735E-01	0.60220939E-02	14.38	1.07
3	23	11	10	0.66611563E-01	0.50045510E-02	13.31	1.12
3	23	12	7	0.17591374E 00	0.25361878E-01	6.94	1.45
3	23	13	19	0.10137904E 00	0.11781406E-01	8.61	1.01
3	23	14	4	0.16244836E 01	0.19563676E 00	8.30	0.98
3	23	15	14	0.56133714E-01	0.87641649E-02	6.40	0.78
3	23	16	18	0.40842995E 01	0.44446214E 00	9.19	0.74
3	23	17	17	0.30357124E 01	0.33836027E 00	8.97	0.89
3	23	18	11	0.13985531E 00	0.21868276E-01	6.40	0.79
3	23	19	28	0.68308492E-01	0.89706274E-02	7.61	0.65
3	23	20	6	0.14706077E 01	0.23233478E 00	6.33	0.65
3	23	21	27	0.25150622E-01	0.50646555E-02	4.97	0.34
3	23	22	5	0.23886596E 01	0.49301305E 00	4.85	0.29
3	23	23	30	0.22200236E 00	0.59779761E-01	3.71	0.18
3	23						83.78
3	23		23	0.37504201E 08	0.16306174E 07	280.89	0.00000
3	23		1251	0.72623749E 07	0.58052557E 04		
3	23		1274	0.44766576E 08			
3	23			0.76192229E 02	0.80061999E 05	13.79	
3	23			0.37666716E-01			

3	24			0.96196925E 02			
3	24	1	13	0.84247053E-01	0.45344656E-02	18.58	47.74
3	24	2	1	0.19611019E 01	0.12932862E 00	15.16	7.02
3	24	3	8	0.11943957E 00	0.65359160E-02	18.27	4.69
3	24	4	20	0.52969899E-01	0.66758099E-02	7.93	3.52
3	24	5	12	0.86614244E-01	0.10031667E-01	8.63	3.10
3	24	6	2	0.17423562E 01	0.12090553E 00	14.41	2.20
3	24	7	16	0.16147244E-01	0.24304594E-02	6.64	1.82
3	24	8	15	0.25063150E-01	0.37366437E-02	6.71	1.48
3	24	9	3	0.15995338E 01	0.13156257E 00	12.16	1.28
3	24	10	9	0.85982882E-01	0.59951741E-02	14.34	1.07
3	24	11	10	0.67275413E-01	0.49834849E-02	13.50	1.12
3	24	12	7	0.17588978E 00	0.25238249E-01	6.97	1.45
3	24	13	19	0.97616368E-01	0.11769333E-01	8.29	1.01
3	24	14	4	0.16204617E 01	0.19468623E 00	8.32	0.98
3	24	15	14	0.55707707E-01	0.87222258E-02	6.39	0.78
3	24	16	18	0.39671305E 01	0.44346213E 00	8.95	0.74
3	24	17	17	0.28816556E 01	0.33935316E 00	8.49	0.89
3	24	18	11	0.13921132E 00	0.21762393E-01	6.40	0.79
3	24	19	28	0.68000191E-01	0.89272996E-02	7.62	0.65
3	24	20	6	0.14552162E 01	0.23124079E 00	6.29	0.65
3	24	21	27	0.25605347E-01	0.50415109E-02	5.08	0.34
3	24	22	5	0.24216545E 01	0.49069330E 00	4.94	0.29
3	24	23	30	0.22180930E 00	0.59488381E-01	3.73	0.18
3	24	24	26	0.13076110E 00	0.35874012E-01	3.65	0.17
3	24						83.95
3	24		24	0.37580580E 08	0.15658575E 07	272.38	0.00000
3	24		1250	0.71859959E 07	0.57487967E 04		
3	24		1274	0.44766576E 08			
3	24			0.75820819E 02	0.76378999E 05	13.29	
3	24			0.35064125E-01			

3	25			0.94688979E 02			
3	25	1	13	0.83439205E-01	0.45232275E-02	18.45	47.74
3	25	2	1	0.19594261E 01	0.12882027E 00	15.21	7.02
3	25	3	8	0.12053623E 00	0.65186398E-02	18.49	4.69
3	25	4	20	0.53098738E-01	0.66496322E-02	7.99	3.52
3	25	5	12	0.87531498E-01	0.99960184E-02	8.76	3.10
3	25	6	2	0.17535125E 01	0.12047673E 00	14.55	2.20
3	25	7	16	0.16327295E-01	0.24215011E-02	6.74	1.82
3	25	8	15	0.25162034E-01	0.37220477E-02	6.76	1.48
3	25	9	3	0.16122297E 01	0.13110081E 00	12.30	1.28
3	25	10	9	0.85097377E-01	0.59775804E-02	14.24	1.07
3	25	11	10	0.66827492E-01	0.49657107E-02	13.46	1.12
3	25	12	7	0.16272053E 00	0.25453213E-01	6.39	1.45
3	25	13	19	0.94294229E-01	0.11766069E-01	8.01	1.01
3	25	14	4	0.16407526E 01	0.19401680E 00	8.46	0.98
3	25	15	14	0.55338562E-01	0.86885933E-02	6.37	0.78
3	25	16	18	0.39224627E 01	0.44192265E 00	8.88	0.74
3	25	17	17	0.29079960E 01	0.33811074E 00	8.60	0.89
3	25	18	11	0.13720324E 00	0.21685212E-01	6.33	0.79
3	25	19	28	0.66843466E-01	0.88990370E-02	7.51	0.65
3	25	20	6	0.14497593E 01	0.23033599E 00	6.29	0.65
3	25	21	27	0.24998380E-01	0.50250181E-02	4.97	0.34
3	25	22	5	0.24366605E 01	0.48878187E 00	4.99	0.29
3	25	23	30	0.22465641E 00	0.59260363E-01	3.79	0.18
3	25	24	26	0.12457720E 00	0.35781762E-01	3.48	0.17
3	25	25	24	0.78254620E 00	0.23697663E 00	3.30	0.14
3	25						84.09
3	25		25	0.37642775E 08	0.15057110E 07	263.99	0.00000
3	25		1249	0.71238009E 07	0.57036036E 04		
3	25		1274	0.44766576E 08			
3	25			0.75522205E 02	0.62194999E 05	10.90	
3	25			0.32440031E-01			

3	26			0.95034221E 02			
3	26	1	13	0.83331846E-01	0.45119484E-02	18.47	47.74
3	26	2	1	0.19583666E 01	0.12849468E 00	15.24	7.02
3	26	3	8	0.11879654E 00	0.65337254E-02	18.18	4.69
3	26	4	20	0.40309480E-01	0.81394186E-02	4.95	3.52
3	26	5	12	0.87787749E-01	0.99711561E-02	8.80	3.10
3	26	6	2	0.17705414E 01	0.12033574E 00	14.71	2.20
3	26	7	16	0.17330560E-01	0.24435569E-02	7.09	1.82
3	26	8	15	0.26681386E-01	0.37546875E-02	7.11	1.48
3	26	9	3	0.16225468E 01	0.13082422E 00	12.40	1.28
3	26	10	9	0.83836997E-01	0.59805438E-02	14.02	1.07
3	26	11	10	0.66799318E-01	0.49531483E-02	13.49	1.12
3	26	12	7	0.15193666E 00	0.25698503E-01	5.91	1.45
3	26	13	19	0.94658292E-01	0.11737045E-01	8.06	1.01
3	26	14	4	0.16539066E 01	0.19358636E 00	8.54	0.98
3	26	15	14	0.56207473E-01	0.86725183E-02	6.48	0.78
3	26	16	18	0.38349010E 01	0.44198545E 00	8.68	0.74
3	26	17	17	0.27523440E 01	0.34210716E 00	8.05	0.89
3	26	18	11	0.13752438E 00	0.21630628E-01	6.36	0.79
3	26	19	28	0.67295313E-01	0.88780690E-02	7.58	0.65
3	26	20	6	0.14670531E 01	0.22984132E 00	6.38	0.65
3	26	21	27	0.24789292E-01	0.50128879E-02	4.95	0.34
3	26	22	5	0.24868479E 01	0.48789561E 00	5.10	0.29
3	26	23	30	0.22659499E 00	0.59114639E-01	3.83	0.18
3	26	24	26	0.13513331E 00	0.35902944E-01	3.76	0.17
3	26	25	24	0.77774296E 00	0.23638323E 00	3.29	0.14
3	26	26	22	0.20766990E 00	0.76604340E-01	2.71	0.09
3	26						84.18
3	26		26	0.37684479E 08	0.14494030E 07	255.41	0.00000
3	26		1248	0.70820964E 07	0.56747568E 04		
3	26		1274	0.44766576E 08			
3	26			0.75330980E 02	0.41704500E 05	7.35	
3	26			0.17229770E-01			

3	27			0.93456725E 02			
3	27	1	13	0.83610762E-01	0.45026920E-02	18.57	47.74
3	27	2	1	0.19394045E 01	0.12839997E 00	15.10	7.02
3	27	3	8	0.11741810E 00	0.65397657E-02	17.95	4.69
3	27	4	20	0.40200804E-01	0.81205480E-02	4.95	3.52
3	27	5	12	0.88244815E-01	0.99494435E-02	8.87	3.10
3	27	6	2	0.17657080E 01	0.12006940E 00	14.71	2.20
3	27	7	16	0.17356590E-01	0.24378801E-02	7.12	1.82
3	27	8	15	0.27028204E-01	0.37482800E-02	7.21	1.48
3	27	9	3	0.16133372E 01	0.13056670E 00	12.36	1.28
3	27	10	9	0.82279412E-01	0.59962498E-02	13.72	1.07
3	27	11	10	0.65690243E-01	0.49597626E-02	13.24	1.12
3	27	12	7	0.15326140E 00	0.25643591E-01	5.98	1.45
3	27	13	19	0.94289118E-01	0.11710531E-01	8.05	1.01
3	27	14	4	0.16206926E 01	0.19355211E 00	8.37	0.98
3	27	15	14	0.54553080E-01	0.86753917E-02	6.29	0.78
3	27	16	18	0.38722618E 01	0.44118631E 00	8.78	0.74
3	27	17	17	0.28127416E 01	0.34208994E 00	8.22	0.89
3	27	18	11	0.13797891E 00	0.21580897E-01	6.39	0.79
3	27	19	28	0.67754381E-01	0.88591089E-02	7.65	0.65
3	27	20	6	0.14820104E 01	0.22937675E 00	6.46	0.65
3	27	21	27	0.25294291E-01	0.50049266E-02	5.05	0.34
3	27	22	5	0.24781361E 01	0.48676948E 00	5.09	0.29
3	27	23	30	0.22301140E 00	0.58992729E-01	3.78	0.18
3	27	24	26	0.13206474E 00	0.35838448E-01	3.69	0.17
3	27	25	24	0.78626899E 00	0.23585464E 00	3.33	0.14
3	27	26	22	0.20590447E 00	0.76428719E-01	2.69	0.09
3	27	27	21	0.10074479E 01	0.38521034E 00	2.62	0.09
3	27						84.27
3	27		27	0.37723113E 08	0.13971523E 07	247.36	0.00000
3	27		1247	0.70434629E 07	0.56483264E 04		
3	27		1274	0.44766576E 08			
3	27			0.75155347E 02	0.38633500E 05	6.84	
3	27			0.16237647E-01			

3	28			0.93688866E 02			
3	28	1	13	0.83797726E-01	0.44956994E-02	18.64	47.74
3	28	2	1	0.18930490E 01	0.12975412E 00	14.59	7.02
3	28	3	8	0.11677460E 00	0.65345334E-02	17.87	4.69
3	28	4	20	0.39865386E-01	0.81079232E-02	4.92	3.52
3	28	5	12	0.88516646E-01	0.99330717E-02	8.91	3.10
3	28	6	2	0.17644343E 01	0.11986462E 00	14.72	2.20
3	28	7	16	0.16203467E-01	0.24847903E-02	6.52	1.82
3	28	8	15	0.26220327E-01	0.37582938E-02	6.98	1.48
3	28	9	3	0.15982233E 01	0.13050814E 00	12.25	1.28
3	28	10	9	0.81813404E-01	0.59893865E-02	13.66	1.07
3	28	11	10	0.64739209E-01	0.49684832E-02	13.03	1.12
3	28	12	7	0.15448631E 00	0.25605121E-01	6.03	1.45
3	28	13	19	0.91771209E-01	0.11741570E-01	7.82	1.01
3	28	14	4	0.16375192E 01	0.19335836E 00	8.47	0.98
3	28	15	14	0.55404969E-01	0.86684183E-02	6.39	0.78
3	28	16	18	0.39311458E 01	0.44117248E 00	8.91	0.74
3	28	17	17	0.28986927E 01	0.34354100E 00	8.44	0.89
3	28	18	11	0.13862946E 00	0.21545717E-01	6.43	0.79
3	28	19	28	0.67983705E-01	0.88444673E-02	7.69	0.65
3	28	20	6	0.14832325E 01	0.22898372E 00	6.48	0.65
3	28	21	27	0.25103320E-01	0.49970271E-02	5.02	0.34
3	28	22	5	0.24588470E 01	0.48600646E 00	5.06	0.29
3	28	23	30	0.22358044E 00	0.58892008E-01	3.80	0.18
3	28	24	26	0.12964809E 00	0.35792366E-01	3.62	0.17
3	28	25	24	0.76253610E 00	0.23567583E 00	3.24	0.14
3	28	26	22	0.20872672E 00	0.76307421E-01	2.74	0.09
3	28	27	21	0.98868371E 00	0.38463577E 00	2.57	0.09
3	28	28	25	0.63608708E 00	0.27652962E 00	2.30	0.07
3	28						84.33
3	28		28	0.37752896E 08	0.13483177E 07	239.53	0.00000
3	28		1246	0.70136794E 07	0.56289562E 04		
3	28		1274	0.44766576E 08			
3	28			0.75026369E 02	0.29783500E 05	5.29	
3	28			0.13743450E-01			

3	29			0.93230379E 02			
3	29	1	13	0.82083103E-01	0.45733182E-02	17.95	47.74
3	29	2	1	0.19063008E 01	0.12977562E 00	14.69	7.02
3	29	3	8	0.11417713E 00	0.66576392E-02	17.15	4.69
3	29	4	20	0.39144829E-01	0.81066436E-02	4.83	3.52
3	29	5	12	0.86648472E-01	0.99663095E-02	8.69	3.10
3	29	6	2	0.17775156E 01	0.11990713E 00	14.82	2.20
3	29	7	16	0.16213004E-01	0.24818943E-02	6.53	1.82
3	29	8	15	0.26893954E-01	0.37693159E-02	7.13	1.48
3	29	9	3	0.15970704E 01	0.13035709E 00	12.25	1.28
3	29	10	9	0.80203634E-01	0.60374731E-02	13.28	1.07
3	29	11	10	0.60683855E-01	0.53693378E-02	11.30	1.12
3	29	12	7	0.15387345E 00	0.25577106E-01	6.02	1.45
3	29	13	19	0.92797902E-01	0.11739338E-01	7.90	1.01
3	29	14	4	0.16435014E 01	0.19315631E 00	8.51	0.98
3	29	15	14	0.55668889E-01	0.86593266E-02	6.43	0.78
3	29	16	18	0.40140146E 01	0.44264368E 00	9.07	0.74
3	29	17	17	0.29181965E 01	0.34328154E 00	8.50	0.89
3	29	18	11	0.13829886E 00	0.21521214E-01	6.43	0.79
3	29	19	28	0.67315900E-01	0.88405885E-02	7.61	0.65
3	29	20	6	0.14915905E 01	0.22875543E 00	6.52	0.65
3	29	21	27	0.25816366E-01	0.50041891E-02	5.16	0.34
3	29	22	5	0.24330780E 01	0.48561381E 00	5.01	0.29
3	29	23	30	0.22104453E 00	0.58837222E-01	3.76	0.18
3	29	24	26	0.13309720E 00	0.35793064E-01	3.72	0.17
3	29	25	24	0.75122205E 00	0.23547015E 00	3.19	0.14
3	29	26	22	0.21820804E 00	0.76368854E-01	2.86	0.09
3	29	27	21	0.89637101E 00	0.38700975E 00	2.32	0.09
3	29	28	25	0.61168209E 00	0.27648212E 00	2.21	0.07
3	29	29	23	0.16286158E 00	0.82318124E-01	1.98	0.05
3	29						84.38
3	29		29	0.37774878E 08	0.13025820E 07	231.95	0.00000
3	29		1245	0.69916979E 07	0.56158216E 04		
3	29		1274	0.44766576E 08			
3	29			0.74938785E 02	0.21981500E 05	3.91	
3	29			0.75409699E-02			

3	30			0.92611129E 02			
3	30	1	13	0.82162459E-01	0.45698619E-02	17.98	47.74
3	30	2	1	0.19065713E 01	0.12967114E 00	14.70	7.02
3	30	3	8	0.11435376E 00	0.66530535E-02	17.19	4.69
3	30	4	20	0.38816823E-01	0.81023177E-02	4.79	3.52
3	30	5	12	0.86395978E-01	0.99593420E-02	8.67	3.10
3	30	6	2	0.17778806E 01	0.11981069E 00	14.84	2.20
3	30	7	16	0.16521003E-01	0.24862426E-02	6.64	1.82
3	30	8	15	0.27178768E-01	0.37698558E-02	7.21	1.48
3	30	9	3	0.16001043E 01	0.13026378E 00	12.28	1.28
3	30	10	9	0.80160295E-01	0.60326596E-02	13.29	1.07
3	30	11	10	0.60726964E-01	0.53650685E-02	11.32	1.12
3	30	12	7	0.14988913E 00	0.25659506E-01	5.84	1.45
3	30	13	19	0.91239748E-01	0.11764222E-01	7.76	1.01
3	30	14	4	0.16425933E 01	0.19300137E 00	8.51	0.98
3	30	15	14	0.55588534E-01	0.86524725E-02	6.42	0.78
3	30	16	18	0.39954828E 01	0.44241599E 00	9.03	0.74
3	30	17	17	0.28826939E 01	0.34361498E 00	8.39	0.89
3	30	18	11	0.13469385E 00	0.21604064E-01	6.23	0.79
3	30	19	28	0.67902068E-01	0.88399256E-02	7.68	0.65
3	30	20	6	0.15157435E 01	0.22899480E 00	6.62	0.65
3	30	21	27	0.25404648E-01	0.50057867E-02	5.08	0.34
3	30	22	5	0.24285734E 01	0.48522944E 00	5.01	0.29
3	30	23	30	0.21922123E 00	0.58799204E-01	3.73	0.18
3	30	24	26	0.12824635E 00	0.35873384E-01	3.57	0.17
3	30	25	24	0.73604663E 00	0.23544300E 00	3.13	0.14
3	30	26	22	0.22621934E 00	0.76446948E-01	2.96	0.09
3	30	27	21	0.91887301E 00	0.38691541E 00	2.37	0.09
3	30	28	25	0.54475002E 00	0.27894096E 00	1.95	0.07
3	30	29	23	0.16856896E 00	0.82317572E-01	2.05	0.05
3	30	30	32	0.15908925E 00	0.91713079E-01	1.73	0.04
3	30						84.42
3	30		30	0.37791748E 08	0.12597249E 07	224.68	0.00000
3	30		1244	0.69748274E 07	0.56067745E 04		
3	30		1274	0.44766576E 08			
3	30			0.74878397E 02	0.16870500E 05	3.01	
3	30			0.69552609E-02			

3	31			0.92348583E 02			
3	31	1	13	0.82204435E-01	0.45676589E-02	18.00	47.74
3	31	2	1	0.19030524E 01	0.12962745E 00	14.68	7.02
3	31	3	8	0.11439238E 00	0.66497713E-02	17.20	4.69
3	31	4	20	0.37600805E-01	0.81387883E-02	4.62	3.52
3	31	5	12	0.86578932E-01	0.99551022E-02	8.70	3.10
3	31	6	2	0.17810069E 01	0.11976884E 00	14.87	2.20
3	31	7	16	0.16510192E-01	0.24850078E-02	6.64	1.82
3	31	8	15	0.27110449E-01	0.37682433E-02	7.19	1.48
3	31	9	3	0.16031031E 01	0.13021391E 00	12.31	1.28
3	31	10	9	0.80293940E-01	0.60302973E-02	13.32	1.07
3	31	11	10	0.60778063E-01	0.53624898E-02	11.33	1.12
3	31	12	7	0.14898196E 00	0.25653793E-01	5.81	1.45
3	31	13	19	0.91083217E-01	0.11758793E-01	7.75	1.01
3	31	14	4	0.16459394E 01	0.19291762E 00	8.53	0.98
3	31	15	14	0.55859444E-01	0.86500272E-02	6.46	0.78
3	31	16	18	0.39743970E 01	0.44241808E 00	8.98	0.74
3	31	17	17	0.29029164E 01	0.34370774E 00	8.45	0.89
3	31	18	11	0.13510695E 00	0.21595003E-01	6.26	0.79
3	31	19	28	0.67915015E-01	0.88355022E-02	7.69	0.65
3	31	20	6	0.14971245E 01	0.22921688E 00	6.53	0.65
3	31	21	27	0.25074074E-01	0.50081372E-02	5.01	0.34
3	31	22	5	0.24335627E 01	0.48499784E 00	5.02	0.29
3	31	23	30	0.22071728E 00	0.58778229E-01	3.76	0.18
3	31	24	26	0.12972351E 00	0.35868956E-01	3.62	0.17
3	31	25	24	0.74148876E 00	0.23535308E 00	3.15	0.14
3	31	26	22	0.23499816E 00	0.76632764E-01	3.07	0.09
3	31	27	21	0.92312379E 00	0.38673202E 00	2.39	0.09
3	31	28	25	0.55022682E 00	0.27882519E 00	1.97	0.07
3	31	29	23	0.17004576E 00	0.82282242E-01	2.07	0.05
3	31	30	32	0.16070196E 00	0.91673458E-01	1.75	0.04
3	31	31	29	0.82794360E 00	0.55232514E 00	1.50	0.03
3	31						84.45
3	31		31	0.37804334E 08	0.12194947E 07	217.72	0.00000
3	31		1243	0.69622414E 07	0.56011596E 04		
3	31		1274	0.44766576E 08			
3	31			0.74840895E 02	0.12586000E 05	2.25	
3	31			0.67807741E-02			

3	32			0.92354384E 02			
3	32	1	13	0.82196813E-01	0.45694391E-02	17.99	47.74
3	32	2	1	0.19038941E 01	0.12971120E 00	14.68	7.02
3	32	3	8	0.11442101E 00	0.66530447E-02	17.20	4.69
3	32	4	20	0.37634550E-01	0.81427236E-02	4.62	3.52
3	32	5	12	0.86750313E-01	0.99779953E-02	8.69	3.10
3	32	6	2	0.17812746E 01	0.11981724E 00	14.87	2.20
3	32	7	16	0.16520226E-01	0.24861951E-02	6.64	1.82
3	32	8	15	0.27123034E-01	0.37699173E-02	7.19	1.48
3	32	9	3	0.16040876E 01	0.13031076E 00	12.31	1.28
3	32	10	9	0.80307723E-01	0.60327433E-02	13.31	1.07
3	32	11	10	0.60800605E-01	0.53650995E-02	11.33	1.12
3	32	12	7	0.14908225E 00	0.25665879E-01	5.81	1.45
3	32	13	19	0.91079698E-01	0.11763170E-01	7.74	1.01
3	32	14	4	0.16452311E 01	0.19300624E 00	8.52	0.98
3	32	15	14	0.55703321E-01	0.86715713E-02	6.42	0.78
3	32	16	18	0.39724704E 01	0.44263712E 00	8.97	0.74
3	32	17	17	0.29009202E 01	0.34391094E 00	8.44	0.89
3	32	18	11	0.13500177E 00	0.21606362E-01	6.25	0.79
3	32	19	28	0.67872708E-01	0.88401046E-02	7.68	0.65
3	32	20	6	0.14973139E 01	0.22930307E 00	6.53	0.65
3	32	21	27	0.25075913E-01	0.50100027E-02	5.01	0.34
3	32	22	5	0.24599054E 01	0.49440731E 00	4.98	0.29
3	32	23	30	0.22150695E 00	0.58869114E-01	3.76	0.18
3	32	24	26	0.12986420E 00	0.35885877E-01	3.62	0.17
3	32	25	24	0.74208471E 00	0.23545036E 00	3.15	0.14
3	32	26	22	0.23476116E 00	0.76666014E-01	3.06	0.09
3	32	27	21	0.92454668E 00	0.38690982E 00	2.39	0.09
3	32	28	25	0.55052742E 00	0.27893091E 00	1.97	0.07
3	32	29	23	0.16944748E 00	0.82341140E-01	2.06	0.05
3	32	30	32	0.16049157E 00	0.91710668E-01	1.75	0.04
3	32	31	29	0.82724985E 00	0.55253606E 00	1.50	0.03
3	32	32	33	-0.99732884E-01	0.35998435E 00	-0.28	0.00
3	32						84.45
3	32		32	0.37804764E 08	0.11813989E 07	210.76	0.00000
3	32		1242	0.69618114E 07	0.56053232E 04		
3	32		1274	0.44766576E 08			
3	32			0.74868706E 02	0.43000000E 03	0.08	
3	32			0.64348152E-02			

APPENDIX 2

COMPUTER OUTPUT OF STEPWISE

MULTIPLE REGRESSION ON ALL DATA

UNDER MODEL II

Program No. 60

MEANS,VARIANCES AND STANDARD DEVIATIONS

60	1	0.88730290E 01	0.77932906E 03	0.27916466E 02
60	2	0.83673833E 02	0.16304630E 05	0.12768958E 03
60	3	0.66753125E 02	0.15353902E 05	0.12391086E 03
60	4	0.24790499E 02	0.79680091E 04	0.89263705E 02
60	5	0.59491757E 01	0.15356470E 04	0.39187332E 02
60	6	0.14355068E 02	0.37772871E 04	0.61459637E 02
60	7	0.17210847E 02	0.37552875E 04	0.61280400E 02
60	8	0.24361303E 03	0.38583035E 05	0.19642565E 03
60	9	0.10343319E 03	0.31590975E 05	0.17773850E 03
60	10	0.89640904E 02	0.50187322E 05	0.22402527E 03
60	11	0.10939293E 02	0.37906316E 04	0.61568105E 02
60	12	0.43138823E 02	0.18069478E 05	0.13442276E 03
60	13	0.35932567E 03	0.11149431E 06	0.33390764E 03
60	14	0.19658650E 02	0.28148976E 04	0.53055608E 02
60	15	0.25537776E 02	0.61118853E 04	0.78178547E 02
60	16	0.35723111E 02	0.11210184E 05	0.10587816E 03
60	17	0.56510568E 02	0.13879456E 05	0.11781110E 03
60	18	0.24295760E 02	0.47774008E 04	0.69118743E 02
60	19	0.24306578E 02	0.37705137E 04	0.61404508E 02
60	20	0.36780227E 02	0.12092495E 05	0.10996588E 03
60	21	0.19594118E 01	0.17833369E 02	0.42229573E 01
60	22	0.20801568E 02	0.57165343E 04	0.75607765E 02
60	23	0.32629412E 02	0.18524288E 04	0.43039851E 02
60	24	0.80039215E 01	0.53855570E 03	0.23206803E 02
60	25	0.49117647E 01	0.61439114E 03	0.24786915E 02
60	26	0.63466623E 01	0.60264558E 03	0.24548841E 02
60	27	0.36488431E 02	0.48105383E 04	0.69358044E 02
60	28	0.31061633E 02	0.11514459E 05	0.10730545E 03
60	29	0.16117647E 00	0.14782675E 02	0.38448244E 01
60	30	0.41785723E 01	0.14276687E 04	0.37784503E 02
60	31	0.14117647E-01	0.25411764E 00	0.50410082E 00
60	32	0.46652782E 01	0.56727660E 03	0.23817569E 02
60	33	0.44642352E 00	0.35777269E 02	0.59814103E 01
60	34	0.14561471E 04	0.45603421E 06	0.67530304E 03
60	35	0.45239215E 01	0.52543332E 01	0.22922332E 01
60	36	0.24162118E 03	0.21569366E 05	0.14686513E 03
60	37	0.71341175E 01	0.50105499E 03	0.22384257E 02
60	38	0.96364705E 03	0.34685015E 06	0.58893985E 03
60	39	0.20267059E 03	0.42180676E 05	0.20537935E 03
60	40	0.79631371E 03	0.28873446E 06	0.53734017E 03
60	41	0.18564377E 01	0.73512475E 00	0.85739416E 00
60	42	0.70110169E 01	0.13512116E 03	0.11624163E 02

SIMPLE CORRELATION COEFFICIENTS

60	1	2	0.07094	-0.02720	-0.02048	-0.01324	0.01011	0.03736
60	1	8	0.06176	0.08251	0.22180	-0.02877	-0.04843	0.26953
60	1	14	-0.02657	0.17608	0.15745	0.12293	0.00090	0.16999
60	1	20	0.04388	0.06711	0.01818	0.11247	0.05895	0.24497
60	1	26	0.08079	0.15788	-0.04004	0.01706	-0.01526	-0.00891
60	1	32	0.03780	0.02785	0.44130	0.31485	0.18610	-0.00851
60	1	38	0.18116	0.14651	0.13875	-0.00585	0.09182	
60	2	3	-0.01624	-0.11478	-0.06823	0.09580	0.03237	0.07379
60	2	9	-0.11919	-0.04088	0.05459	0.02953	-0.11221	-0.02472
60	2	15	-0.03183	-0.06319	-0.07505	-0.04073	-0.09205	-0.09865
60	2	21	0.00408	-0.09530	-0.07246	-0.04317	-0.00414	-0.03073
60	2	27	-0.00267	0.09670	-0.00737	0.06453	0.05433	-0.00612
60	2	33	0.00517	0.09829	0.03457	0.37538	0.15681	0.29818
60	2	39	0.16021	0.23495	-0.09344	-0.00563		
60	3	4	0.08930	-0.05163	-0.04430	-0.01003	0.18130	-0.04602
60	3	10	-0.05957	-0.01372	-0.00681	-0.00295	0.00368	-0.06693
60	3	16	-0.03243	-0.07307	-0.07162	-0.08200	-0.06303	0.04886
60	3	22	-0.04422	0.02665	-0.06005	0.02973	-0.04309	-0.01038
60	3	28	-0.05059	-0.02260	-0.01058	-0.01510	-0.02559	0.01653
60	3	34	0.11100	0.03843	0.40060	0.14271	0.34664	0.16843
60	3	40	0.35496	0.03830	0.03038			
60	4	5	0.06739	-0.01931	-0.03048	0.11747	-0.08118	-0.03323
60	4	11	0.03124	0.01406	-0.04753	0.12854	-0.07541	0.00863
60	4	17	-0.08875	-0.04318	-0.03543	-0.02672	0.08722	-0.04325
60	4	23	0.00235	-0.05400	-0.03496	-0.01981	-0.00144	-0.00127
60	4	29	-0.01165	-0.02757	-0.00778	-0.01445	-0.00489	0.06130
60	4	35	0.03506	0.24344	0.09861	0.19918	0.09921	0.18953
60	4	41	-0.00160	0.02043				
60	5	6	0.01406	0.07760	0.12638	-0.04863	-0.05172	0.02086
60	5	12	0.06983	0.00023	0.32064	-0.01840	-0.05126	-0.05338
60	5	18	-0.00097	-0.05230	-0.03747	0.03012	-0.03697	0.02683
60	5	24	-0.00527	-0.01878	-0.03152	0.08465	-0.00991	-0.00637
60	5	30	-0.01242	-0.00425	0.01131	0.18627	0.08159	0.05262
60	5	36	0.14837	0.03884	0.15047	0.10264	0.09059	-0.00560
60	5	42	0.08797					
60	6	7	0.20368	-0.06423	-0.02183	-0.05269	0.03151	0.01482
60	6	13	-0.06105	0.03974	0.02819	-0.01866	-0.03060	0.02182
60	6	19	0.00859	0.02457	-0.03432	-0.00235	-0.06857	0.03862
60	6	25	-0.01288	0.02455	-0.00369	0.03895	0.06415	0.20397
60	6	31	-0.00655	-0.02687	0.01797	0.07247	0.04149	0.15654
60	6	37	0.07146	0.11797	0.11213	0.05947	-0.06265	-0.00787
60	7	8	-0.05768	-0.08333	-0.08604	0.02011	0.01611	-0.00418
60	7	14	0.00814	0.07347	-0.06160	0.00892	0.07387	0.01404
60	7	20	0.09610	-0.04912	0.16296	-0.06130	0.16713	-0.03779
60	7	26	0.02894	-0.05593	0.10172	0.02933	0.23705	-0.00787
60	7	32	0.08798	0.04000	0.10753	0.08513	0.10941	0.03074
60	7	38	0.12430	0.08922	0.05452	0.03157	-0.02798	
60	8	9	-0.03680	-0.06665	-0.02184	0.01019	0.31269	0.14190
60	8	15	-0.06746	0.00412	-0.08876	-0.00432	-0.07229	0.09642
60	8	21	0.11089	0.12677	0.24390	-0.05931	0.04383	-0.04832
60	8	27	0.12320	0.00044	-0.01281	-0.07512	-0.02675	-0.05668
60	8	33	0.02706	0.41547	0.15715	0.52435	0.06220	0.57561

60	8	39	0.16486	0.57370	0.24946	0.12248		
60	9	10	0.01236	-0.06363	-0.08840	0.37981	-0.02345	0.12358
60	9	16	0.15970	0.13460	0.04690	0.07935	0.13811	0.07814
60	9	22	0.13720	0.18601	0.08874	0.09084	0.05412	0.13278
60	9	28	-0.07556	-0.01407	-0.04906	-0.00373	-0.00654	-0.01232
60	9	34	0.35081	0.25290	0.18451	-0.06636	0.26332	0.17402
60	9	40	0.22157	0.26439	0.12309			
60	10	11	-0.05314	-0.08498	0.50708	-0.09746	0.01316	0.17181
60	10	17	0.06144	-0.08617	0.11742	0.01001	0.08489	-0.00632
60	10	23	0.52721	0.07876	0.18288	-0.04317	0.09915	-0.06959
60	10	29	-0.01679	-0.02946	-0.01121	-0.02500	-0.00444	0.39185
60	10	35	0.28406	0.22410	-0.04305	0.26505	0.25917	0.17970
60	10	41	0.34214	0.23427				
60	11	12	-0.05629	-0.18613	-0.04518	-0.05308	-0.06000	-0.08529
60	11	18	-0.05173	-0.06461	-0.05657	-0.01112	-0.04645	-0.07077
60	11	24	0.00890	-0.03153	-0.00650	0.04148	0.02752	-0.00745
60	11	30	0.03001	-0.00498	0.09776	-0.01262	-0.05500	-0.01576
60	11	36	0.04240	0.01137	0.00563	0.01663	0.00625	-0.05311
60	11	42	0.03221					
60	12	13	-0.34322	0.08946	-0.09741	-0.09805	-0.14249	-0.07952
60	12	19	-0.10494	-0.10484	-0.01545	-0.08806	-0.00266	-0.06112
60	12	25	-0.05815	-0.07510	-0.00140	0.49223	-0.01346	0.10457
60	12	31	-0.00899	-0.02004	0.08136	-0.04419	-0.08101	-0.01058
60	12	37	-0.00630	0.00344	-0.03811	0.00455	0.05304	0.00607
60	13	14	-0.01606	0.10113	0.22823	0.20864	0.03380	0.21492
60	13	20	0.17288	0.08473	0.17646	0.49649	0.13233	0.17647
60	13	26	0.02331	0.29454	-0.22948	-0.00866	-0.05714	-0.01985
60	13	32	-0.01745	-0.01688	0.69091	0.46491	0.33625	-0.05094
60	13	38	0.40813	0.29658	0.34845	0.47023	0.23820	
60	14	15	-0.07179	-0.05823	-0.10545	-0.04700	-0.05646	-0.04836
60	14	21	0.09005	-0.05721	-0.00339	-0.00771	-0.05755	-0.02124
60	14	27	0.13133	0.00509	-0.01554	-0.01078	-0.01039	-0.00771
60	14	33	0.00455	0.08669	-0.02125	0.12805	0.01962	0.11514
60	14	39	0.05268	0.08763	-0.01114	-0.02070		
60	15	16	-0.10546	0.21279	0.22679	0.20281	0.26393	-0.05093
60	15	22	0.10354	-0.08953	0.05277	0.09423	0.10281	-0.01226
60	15	28	-0.09200	0.04512	-0.00001	-0.00916	0.03062	0.01062
60	15	34	0.21402	0.17879	-0.03688	0.01848	-0.01477	0.02632
60	15	40	-0.00990	0.07977	-0.01116			
60	16	17	0.42629	0.00519	0.31032	0.16618	0.00555	0.05679
60	16	23	0.12428	0.01941	0.24881	0.01709	0.07623	-0.09774
60	16	29	-0.00212	0.00563	-0.00919	0.00035	-0.00174	0.31695
60	16	35	0.31034	0.04324	-0.00591	0.08681	0.05690	0.04269
60	16	41	0.22729	0.13142				
60	17	18	0.01823	0.33684	0.35011	-0.07903	0.28497	-0.01432
60	17	24	0.03773	0.05979	0.17488	0.04738	-0.13225	-0.02012
60	17	30	-0.00787	-0.01344	0.06886	-0.02186	0.29655	0.29538
60	17	36	-0.09785	0.00409	-0.04234	-0.00568	-0.06217	0.21451
60	17	42	0.04747					
60	18	19	0.02222	0.22837	-0.05001	0.17835	-0.13301	0.05028
60	18	25	-0.03532	0.09930	-0.01471	-0.09147	0.05636	0.00282
60	18	31	-0.00985	0.02631	-0.00913	0.12287	0.08865	-0.05876
60	18	37	0.01193	-0.01846	-0.00712	-0.01113	0.02373	0.00483
60	19	20	0.18689	-0.00969	0.09303	0.02369	0.12022	0.19094

60	19	26	0.14051	0.01004	-0.09515	0.01183	0.01056	-0.01109
60	19	32	0.10891	-0.00736	0.29086	0.25335	-0.07256	-0.00817
60	19	38	-0.05603	0.00565	-0.07108	0.13043	0.07808	
60	20	21	-0.01575	0.64044	0.01615	0.04853	0.05560	0.13443
60	20	27	0.07327	-0.09655	0.07475	-0.03257	-0.00937	0.02450
60	20	33	-0.00313	0.31287	0.22875	0.00822	0.01933	0.10253
60	20	39	-0.01259	0.10299	0.28880	0.05805		
60	21	22	-0.00806	0.18423	-0.01609	0.05093	0.01096	0.00487
60	21	28	-0.02366	-0.01947	-0.00742	-0.01300	-0.04747	0.01388
60	21	34	0.12626	0.02115	0.15628	0.05752	0.16117	0.04773
60	21	40	0.15410	0.02390	0.05498			
60	22	23	0.00570	0.05471	-0.00686	0.02243	0.06922	-0.07657
60	22	29	-0.01154	-0.02088	-0.00771	-0.02208	-0.01480	0.25683
60	22	35	0.17056	0.02778	0.03020	0.13335	-0.03873	0.13980
60	22	41	0.24909	0.04054				
60	23	24	0.06108	0.14881	-0.07844	0.08933	0.00754	-0.03181
60	23	30	-0.01757	-0.02125	-0.06977	-0.00702	0.40559	0.21897
60	23	36	0.30175	-0.00784	0.35388	0.25239	0.29679	0.33304
60	23	42	0.21238					
60	24	25	0.06846	0.07560	0.05334	0.00445	-0.00804	0.02409
60	24	31	-0.00967	0.07327	0.00568	0.14498	0.13624	-0.00188
60	24	37	-0.02728	0.01168	0.20853	-0.08707	0.06280	-0.00349
60	25	26	0.04082	0.06643	-0.05741	-0.00831	-0.01838	-0.00555
60	25	32	0.13079	0.01282	0.24444	0.18009	0.08854	-0.01285
60	25	38	0.08886	0.03780	0.08549	0.09999	0.03801	
60	26	27	-0.02134	-0.03880	-0.01085	0.00044	-0.00725	0.11536
60	26	33	0.00488	0.09921	0.09255	-0.04754	-0.01601	-0.04309
60	26	39	0.00059	-0.05190	-0.00215	-0.00988		
60	27	28	-0.12437	0.03649	-0.04062	0.00392	0.04745	0.01244
60	27	34	0.29604	0.18667	0.11794	0.02687	0.15473	0.10424
60	27	40	0.12325	0.18597	0.11449			
60	28	29	-0.01214	0.13299	-0.00782	-0.03891	0.02216	-0.00261
60	28	35	-0.03179	0.00695	-0.00175	-0.00576	-0.03291	-0.00445
60	28	41	0.05977	-0.03989				
60	29	30	-0.00464	-0.00117	-0.00822	-0.00313	0.01756	0.01112
60	29	36	0.01657	-0.00683	0.01617	0.01660	0.01459	0.01066
60	29	42	-0.01632					
60	30	31	-0.00310	0.02761	0.05586	0.05005	0.01270	0.11776
60	30	37	0.01204	0.10195	0.04569	0.07728	0.01346	0.00169
60	31	32	0.00828	-0.00209	-0.06044	-0.05531	-0.00527	0.00609
60	31	38	-0.00755	-0.01401	-0.00502	-0.00511	-0.00967	
60	32	33	-0.00290	0.03692	0.02613	-0.06628	-0.01112	-0.06705
60	32	39	-0.01441	-0.06669	0.02406	-0.04133		
60	33	34	0.02927	-0.01384	0.05731	0.01611	0.05141	0.00660
60	33	40	0.05538	0.01704	-0.00921			
60	34	35	0.68598	0.63163	0.06032	0.68486	0.41847	0.56804
60	34	41	0.24625	0.25901				
60	35	36	0.33202	0.05955	0.38143	0.26935	0.31135	0.09760
60	35	42	0.18790					
60	36	37	0.12254	0.94111	0.48509	0.80411	0.14543	0.20031
60	37	38	0.13756	0.05402	0.14717	-0.02766	0.00981	
60	38	39	0.42796	0.87037	0.24014	0.23693		
60	39	40	0.15084	0.10236	0.27081			
60	40	41	0.22720	0.19709				
60	41	42	0.15294					

REGRESSION COEFFICIENTS AND ANALYSIS OF VARIANCE

60	1			0.95405621E 03			
60	1	1	13	0.13973143E 01	0.40978931E-01	34.10	47.74
60	1						47.74
60	1		1	0.27733863E 09	0.27733863E 09	1162.70	0.00000
60	1		1273	0.30364895E 09	0.23853020E 06		
60	1		1274	0.58098758E 09			
60	1			0.48839554E 03			
60	2			0.94889440E 03			
60	2	1	13	0.12473763E 01	0.39610242E-01	31.49	47.74
60	2	2	1	0.66536922E 01	0.47377639E 00	14.04	7.02
60	2						54.75
60	2		2	0.31810104E 09	0.15905052E 09	769.58	0.00000
60	2		1272	0.26288654E 09	0.20667181E 06		
60	2		1274	0.58098758E 09			
60	2			0.45461171E 03	0.40762408E 08	197.23	
60	2			0.92735090E 00			
60	3			0.80961718E 03			
60	3	1	13	0.11001430E 01	0.39433668E-01	27.90	47.74
60	3	2	1	0.67876920E 01	0.44886922E 00	15.12	7.02
60	3	3	8	0.78400126E 00	0.64676589E-01	12.12	4.69
60	3						59.44
60	3		3	0.34534372E 09	0.11511457E 09	620.90	0.00000
60	3		1271	0.23564386E 09	0.18540036E 06		
60	3		1274	0.58098758E 09			
60	3			0.43058142E 03	0.27242680E 08	146.94	
60	3			0.83617009E 00			
60	4			0.79596090E 03			
60	4	1	13	0.10389676E 01	0.38109184E-01	27.26	47.74
60	4	2	1	0.67959579E 01	0.42913380E 00	15.84	7.02
60	4	3	8	0.75326410E 00	0.61896178E-01	12.17	4.69
60	4	4	20	0.11705417E 01	0.10659082E 00	10.98	3.52
60	4						62.96
60	4		4	0.36577940E 09	0.91444850E 08	539.64	0.00000
60	4		1270	0.21520818E 09	0.16945526E 06		
60	4		1274	0.58098758E 09			
60	4			0.41164944E 03	0.20435684E 08	120.60	
60	4			0.80951462E 00			

60	5			0.72222638E 03			
60	5	1	13	0.11884655E 01	0.39044946E-01	30.44	47.74
60	5	2	1	0.65636088E 01	0.41150450E 00	15.95	7.02
60	5	3	8	0.66588087E 00	0.59824689E-01	11.13	4.69
60	5	4	20	0.12318369E 01	0.10222993E 00	12.05	3.52
60	5	5	12	0.95299236E 00	0.88500225E-01	10.77	3.10
60	5						66.06
60	5		5	0.38379767E 09	0.76759533E 08	493.98	0.00000
60	5		1269	0.19718991E 09	0.15539000E 06		
60	5		1274	0.58098758E 09			
60	5			0.39419538E 03	0.18018268E 08	115.96	
60	5			0.69766020E 00			
60	6			0.65121013E 03			
60	6	1	13	0.12443901E 01	0.38241302E-01	32.54	47.74
60	6	2	1	0.61452728E 01	0.40059395E 00	15.34	7.02
60	6	3	8	0.59662301E 00	0.58345652E-01	10.23	4.69
60	6	4	20	0.13147931E 01	0.99295147E-01	13.24	3.52
60	6	5	12	0.98208093E 00	0.85673787E-01	11.46	3.10
60	6	6	2	0.80310805E 00	0.85665167E-01	9.37	2.20
60	6						68.26
60	6		6	0.39657969E 09	0.66096616E 08	454.48	0.00000
60	6		1268	0.18440789E 09	0.14543209E 06		
60	6		1274	0.58098758E 09			
60	6			0.38135559E 03	0.12782024E 08	87.89	
60	6			0.66560298E 00			
60	7			0.63532582E 03			
60	7	1	13	0.11895155E 01	0.37666813E-01	31.58	47.74
60	7	2	1	0.57839735E 01	0.39127297E 00	14.78	7.02
60	7	3	8	0.63194673E 00	0.56814484E-01	11.12	4.69
60	7	4	20	0.12012956E 01	0.97309657E-01	12.35	3.52
60	7	5	12	0.99021944E 00	0.83220978E-01	11.90	3.10
60	7	6	2	0.82582235E 00	0.83247686E-01	9.92	2.20
60	7	7	16	0.89929046E 00	0.10247495E 00	8.78	1.82
60	7						70.08
60	7		7	0.40714642E 09	0.58163773E 08	423.91	0.00000
60	7		1267	0.17384116E 09	0.13720692E 06		
60	7		1274	0.58098758E 09			
60	7			0.37041452E 03	0.10566724E 08	77.01	
60	7			0.60893878E 00			

60	8			0.60430366E 03			
60	8	1	13	0.11712052E 01	0.36806500E-01	31.82	47.74
60	8	2	1	0.52000268E 01	0.38833606E 00	13.39	7.02
60	8	3	8	0.68878241E 00	0.55852931E-01	12.33	4.69
60	8	4	20	0.97197342E 00	0.99021975E-01	9.82	3.52
60	8	5	12	0.10257231E 01	0.81285116E-01	12.62	3.10
60	8	6	2	0.83360476E 00	0.81199120E-01	10.27	2.20
60	8	7	16	0.10696138E 01	0.10212406E 00	10.47	1.82
60	8	8	15	0.11396556E 01	0.14036477E 00	8.12	1.48
60	8						71.56
60	8		8	0.41575051E 09	0.51968813E 08	398.17	0.00000
60	8		1266	0.16523708E 09	0.13051902E 06		
60	8		1274	0.58098758E 09			
60	8			0.36127416E 03	0.86040879E 07	65.92	
60	8			0.51806772E 00			
60	9			0.57019871E 03			
60	9	1	13	0.11870688E 01	0.36041918E-01	32.94	47.74
60	9	2	1	0.52265817E 01	0.37966610E 00	13.77	7.02
60	9	3	8	0.60458016E 00	0.55682568E-01	10.86	4.69
60	9	4	20	0.10210887E 01	0.97016107E-01	10.52	3.52
60	9	5	12	0.10509240E 01	0.79534119E-01	13.21	3.10
60	9	6	2	0.86199998E 00	0.79468195E-01	10.85	2.20
60	9	7	16	0.10811175E 01	0.99851068E-01	10.83	1.82
60	9	8	15	0.11729570E 01	0.13729316E 00	8.54	1.48
60	9	9	3	0.63144493E 00	0.81799808E-01	7.72	1.28
60	9						72.84
60	9		9	0.42318399E 09	0.47020444E 08	376.93	0.00000
60	9		1265	0.15780359E 09	0.12474592E 06		
60	9		1274	0.58098758E 09			
60	9			0.35319388E 03	0.74334879E 07	59.59	
60	9			0.49376475E 00			
60	10			0.54873520E 03			
60	10	1	13	0.10861039E 01	0.38014007E-01	28.57	47.74
60	10	2	1	0.53495759E 01	0.37263825E 00	14.36	7.02
60	10	3	8	0.67047314E 00	0.55354992E-01	12.11	4.69
60	10	4	20	0.98376288E 00	0.95261272E-01	10.33	3.52
60	10	5	12	0.10039163E 01	0.78252349E-01	12.83	3.10
60	10	6	2	0.88972299E 00	0.78010252E-01	11.41	2.20
60	10	7	16	0.10276603E 01	0.98180571E-01	10.47	1.82
60	10	8	15	0.10970630E 01	0.13502174E 00	8.13	1.48
60	10	9	3	0.63472004E 00	0.80202665E-01	7.91	1.28
60	10	10	9	0.43805351E 00	0.60790420E-01	7.21	1.07
60	10						73.91
60	10		10	0.42941086E 09	0.42941086E 08	358.09	0.00000
60	10		1264	0.15157672E 09	0.11991829E 06		
60	10		1274	0.58098758E 09			
60	10			0.34629221E 03	0.62268639E 07	51.93	
60	10			0.39810970E 00			

60	11			0.54179664E 03			
60	11	1	13	0.88083285E 00	0.46096124E-01	19.11	47.74
60	11	2	1	0.51247811E 01	0.36588280E 00	14.01	7.02
60	11	3	8	0.81749723E 00	0.57572458E-01	14.20	4.69
60	11	4	20	0.10152986E 01	0.93317110E-01	10.88	3.52
60	11	5	12	0.90108482E 00	0.77782925E-01	11.58	3.10
60	11	6	2	0.87353797E 00	0.76371552E-01	11.44	2.20
60	11	7	16	0.97919915E 00	0.96294880E-01	10.17	1.82
60	11	8	15	0.11339123E 01	0.13222356E 00	8.58	1.48
60	11	9	3	0.64426720E 00	0.78497112E-01	8.21	1.28
60	11	10	9	0.57891978E 00	0.62353768E-01	9.28	1.07
60	11	11	10	0.41374347E 00	0.54865487E-01	7.54	1.12
60	11						75.03
60	11		11	0.43594165E 09	0.39631059E 08	345.09	0.00000
60	11		1263	0.14504593E 09	0.11484238E 06		
60	11		1274	0.58098758E 09			
60	11			0.33888403E 03	0.65307920E 07	56.87	
60	11			0.23754342E 00			
60	12			0.51431716E 03			
60	12	1	13	0.82463525E 00	0.45210813E-01	18.24	47.74
60	12	2	1	0.49846466E 01	0.35562186E 00	14.02	7.02
60	12	3	8	0.88780823E 00	0.56468695E-01	15.72	4.69
60	12	4	20	0.92949359E 00	0.91131266E-01	10.20	3.52
60	12	5	12	0.85637984E 00	0.75696167E-01	11.31	3.10
60	12	6	2	0.84491506E 00	0.74226611E-01	11.38	2.20
60	12	7	16	0.10289710E 01	0.93671204E-01	10.98	1.82
60	12	8	15	0.11036817E 01	0.12843267E 00	8.59	1.48
60	12	9	3	0.63751406E 00	0.76223210E-01	8.36	1.28
60	12	10	9	0.66040335E 00	0.61246829E-01	10.78	1.07
60	12	11	10	0.48894460E 00	0.53952965E-01	9.06	1.12
60	12	12	7	0.13678870E 01	0.15526586E 00	8.81	1.45
60	12						76.48
60	12		12	0.44434541E 09	0.37028784E 08	341.99	0.00000
60	12		1262	0.13664217E 09	0.10827430E 06		
60	12		1274	0.58098758E 09			
60	12			0.32905060E 03	0.84037639E 07	77.62	
60	12			0.22299946E 00			

LIST OF WORKING PLACES - (Continued)

Working Place No.	No. of Cont. Rec. Jan./63 June./64	Feb./62 Nov./64	Mining Method	Ore Control	Ground Control	Breaking
0678		4	B		3	2
0681		8	B		3	2
0686		4	B		3	2
0689		2	B		1	2
0697		2	B		1	2
0773	19	67	B		1	2
0774	2	7	?(S)			
0776	12	17	E		1	2
0744	1	6	B		3	2
0801	32	36	A		2	2
0809	6	36	B		1	2
0873	20	34	B		1	2
0876	18	27	C		1	2
0879	8	16	C		1	2
0826		1	?(S)			
0916		4	B S		2	2
0903		1				
0901		13	A		1	2
0909	15	51	B		1	2
0944	18	33	B		3	2
0961	11	11	B		1	2
0964	12	16	D		1	2
0965	8	13	B		2	2
0973	73	152	C		1	2
0976	34	49	C		1	2
0979	47	77	C		1	2
0973		1	?(S)			
0972		1	?(S)			
1001	3	8	A		2	2
1009	18	37	B		1	2

60	15			0.45686794E 03			
60	15	1	13	0.78846048E 00	0.43116345E-01	18.29	47.74
60	15	2	1	0.47589424E 01	0.33528099E 00	14.19	7.02
60	15	3	8	0.85336428E 00	0.54228219E-01	15.74	4.69
60	15	4	20	0.91239929E 00	0.86028531E-01	10.61	3.52
60	15	5	12	0.82490697E 00	0.71426732E-01	11.55	3.10
60	15	6	2	0.96597560E 00	0.70652318E-01	13.67	2.20
60	15	7	16	0.83599473E 00	0.91853985E-01	9.10	1.82
60	15	8	15	0.10048279E 01	0.12304185E 00	8.17	1.48
60	15	9	3	0.65057972E 00	0.71904824E-01	9.05	1.28
60	15	10	9	0.72338844E 00	0.57889732E-01	12.50	1.07
60	15	11	10	0.53362007E 00	0.50995863E-01	10.46	1.12
60	15	12	7	0.13837393E 01	0.14604172E 00	9.47	1.45
60	15	13	19	0.12547639E 01	0.15746515E 00	7.97	1.01
60	15	14	4	0.69474939E 00	0.10031872E 00	6.93	0.98
60	15	15	14	0.11562225E 01	0.16816529E 00	6.88	0.78
60	15						79.25
60	15		15	0.46044559E 09	0.30696373E 08	320.61	0.00000
60	15		1259	0.12054199E 09	0.95744234E 05		
60	15		1274	0.58098758E 09			
60	15			0.30942565E 03	0.45260840E 07	47.27	
60	15			0.16049761E 00			
60	16			0.43555348E 03			
60	16	1	13	0.77746275E 00	0.42389040E-01	18.34	47.74
60	16	2	1	0.48075669E 01	0.32946371E 00	14.59	7.02
60	16	3	8	0.85890008E 00	0.53281032E-01	16.12	4.69
60	16	4	20	0.81807354E 00	0.85641443E-01	9.55	3.52
60	16	5	12	0.84229311E 00	0.70217332E-01	12.00	3.10
60	16	6	2	0.97801560E 00	0.69432663E-01	14.09	2.20
60	16	7	16	0.82198544E 00	0.90262518E-01	9.11	1.82
60	16	8	15	0.86040418E 00	0.12272150E 00	7.01	1.48
60	16	9	3	0.67877648E 00	0.70761690E-01	9.59	1.28
60	16	10	9	0.73263415E 00	0.56888155E-01	12.88	1.07
60	16	11	10	0.56700422E 00	0.50338133E-01	11.26	1.12
60	16	12	7	0.13494788E 01	0.14356219E 00	9.40	1.45
60	16	13	19	0.13168712E 01	0.15496487E 00	8.50	1.01
60	16	14	4	0.70920658E 00	0.98577851E-01	7.19	0.98
60	16	15	14	0.11930922E 01	0.16529732E 00	7.22	0.78
60	16	16	18	0.88708741E 00	0.13013932E 00	6.82	0.74
60	16						79.99
60	16		16	0.46473919E 09	0.29046199E 08	314.33	0.00000
60	16		1258	0.11624839E 09	0.92407302E 05		
60	16		1274	0.58098758E 09			
60	16			0.30398569E 03	0.42936040E 07	46.46	
60	16			0.14387874E 00			

60	17			0.40807702E 03			
60	17	1	13	0.73533924E 00	0.41820860E-01	17.58	47.74
60	17	2	1	0.47978541E 01	0.32220961E 00	14.89	7.02
60	17	3	8	0.91852728E 00	0.52689397E-01	17.43	4.69
60	17	4	20	0.64634129E 00	0.86722371E-01	7.45	3.52
60	17	5	12	0.84921760E 00	0.68676748E-01	12.37	3.10
60	17	6	2	0.98133660E 00	0.67904766E-01	14.45	2.20
60	17	7	16	0.55726838E 00	0.94838297E-01	5.88	1.82
60	17	8	15	0.69994597E 00	0.12184436E 00	5.74	1.48
60	17	9	3	0.68661592E 00	0.69210743E-01	9.92	1.28
60	17	10	9	0.75952267E 00	0.55746499E-01	13.62	1.07
60	17	11	10	0.61500116E 00	0.49629103E-01	12.39	1.12
60	17	12	7	0.13804435E 01	0.14045872E 00	9.83	1.45
60	17	13	19	0.11667593E 01	0.15282150E 00	7.63	1.01
60	17	14	4	0.75486803E 00	0.96591916E-01	7.82	0.98
60	17	15	14	0.12567130E 01	0.16187115E 00	7.76	0.78
60	17	16	18	0.99778887E 00	0.12809604E 00	7.79	0.74
60	17	17	17	0.67072999E 00	0.87842491E-01	7.64	0.89
60	17						80.88
60	17		17	0.46989204E 09	0.27640708E 08	312.74	0.00000
60	17		1257	0.11109554E 09	0.88381494E 05		
60	17		1274	0.58098758E 09			
60	17			0.29729025E 03	0.51528480E 07	58.30	
60	17			0.93198046E-01			
60	18			0.38056847E 03			
60	18	1	13	0.80065955E 00	0.41921860E-01	19.10	47.74
60	18	2	1	0.47330611E 01	0.31575661E 00	14.99	7.02
60	18	3	8	0.88492883E 00	0.51816399E-01	17.08	4.69
60	18	4	20	0.65232468E 00	0.84956275E-01	7.68	3.52
60	18	5	12	0.92891702E 00	0.68144883E-01	13.63	3.10
60	18	6	2	0.97392596E 00	0.66526484E-01	14.64	2.20
60	18	7	16	0.56928693E 00	0.92917063E-01	6.13	1.82
60	18	8	15	0.72611606E 00	0.11941070E 00	6.08	1.48
60	18	9	3	0.70385684E 00	0.67838791E-01	10.38	1.28
60	18	10	9	0.73350594E 00	0.54723519E-01	13.40	1.07
60	18	11	10	0.58428237E 00	0.48795813E-01	11.97	1.12
60	18	12	7	0.13316719E 01	0.13775215E 00	9.67	1.45
60	18	13	19	0.11676102E 01	0.14970246E 00	7.80	1.01
60	18	14	4	0.74084733E 00	0.94639737E-01	7.83	0.98
60	18	15	14	0.13144844E 01	0.15876240E 00	8.28	0.78
60	18	16	18	0.10368534E 01	0.12559431E 00	8.26	0.74
60	18	17	17	0.68787336E 00	0.86081287E-01	7.99	0.89
60	18	18	11	0.10117564E 01	0.13777768E 00	7.34	0.79
60	18						81.67
60	18		18	0.47446549E 09	0.26359194E 08	310.80	0.00000
60	18		1256	0.10652209E 09	0.84810578E 05		
60	18		1274	0.58098758E 09			
60	18			0.29122256E 03	0.45734520E 07	53.93	
60	18			0.86221995E-01			

60	19			0.36836510E 03			
60	19	1	13	0.81269963E 00	0.41221685E-01	19.72	47.74
60	19	2	1	0.47391600E 01	0.31019874E 00	15.28	7.02
60	19	3	8	0.87431078E 00	0.50927977E-01	17.17	4.69
60	19	4	20	0.66152277E 00	0.83471465E-01	7.93	3.52
60	19	5	12	0.71024124E 00	0.74241154E-01	9.57	3.10
60	19	6	2	0.94343044E 00	0.65508312E-01	14.40	2.20
60	19	7	16	0.58128637E 00	0.91298167E-01	6.37	1.82
60	19	8	15	0.75081519E 00	0.11736438E 00	6.40	1.48
60	19	9	3	0.73488510E 00	0.66799846E-01	11.00	1.28
60	19	10	9	0.72617913E 00	0.53770819E-01	13.51	1.07
60	19	11	10	0.58125848E 00	0.47938775E-01	12.13	1.12
60	19	12	7	0.12242504E 01	0.13624224E 00	8.99	1.45
60	19	13	19	0.11756475E 01	0.14707155E 00	7.99	1.01
60	19	14	4	0.74063194E 00	0.92973528E-01	7.97	0.98
60	19	15	14	0.13732042E 01	0.15620518E 00	8.79	0.78
60	19	16	18	0.10848791E 01	0.12358429E 00	8.78	0.74
60	19	17	17	0.70619744E 00	0.84608508E-01	8.35	0.89
60	19	18	11	0.98467663E 00	0.13541033E 00	7.27	0.79
60	19	19	28	0.59729749E 00	0.87665614E-01	6.81	0.65
60	19						82.32
60	19		19	0.47826515E 09	0.25171850E 08	307.53	0.00000
60	19		1255	0.10272243E 09	0.81850542E 05		
60	19		1274	0.58098758E 09			
60	19			0.28609534E 03	0.37996560E 07	46.42	
60	19			0.62599100E-01			

60	20			0.35643097E 03			
60	20	1	13	0.81705480E 00	0.40481228E-01	20.18	47.74
60	20	2	1	0.47229230E 01	0.30459878E 00	15.51	7.02
60	20	3	8	0.89141105E 00	0.50068419E-01	17.80	4.69
60	20	4	20	0.64497333E 00	0.81997186E-01	7.87	3.52
60	20	5	12	0.71220873E 00	0.72899276E-01	9.77	3.10
60	20	6	2	0.90283079E 00	0.64592135E-01	13.98	2.20
60	20	7	16	0.56922591E 00	0.89664330E-01	6.35	1.82
60	20	8	15	0.73857881E 00	0.11525582E 00	6.41	1.48
60	20	9	3	0.74787929E 00	0.65618974E-01	11.40	1.28
60	20	10	9	0.72350811E 00	0.52799948E-01	13.70	1.07
60	20	11	10	0.58748660E 00	0.47080589E-01	12.48	1.12
60	20	12	7	0.10495296E 01	0.13615225E 00	7.71	1.45
60	20	13	19	0.11581389E 01	0.14443446E 00	8.02	1.01
60	20	14	4	0.74263199E 00	0.91292834E-01	8.13	0.98
60	20	15	14	0.13225756E 01	0.15355594E 00	8.61	0.78
60	20	16	18	0.10850107E 01	0.12134963E 00	8.94	0.74
60	20	17	17	0.73128604E 00	0.83158078E-01	8.79	0.89
60	20	18	11	0.96807919E 00	0.13298357E 00	7.28	0.79
60	20	19	28	0.59428248E 00	0.86081545E-01	6.90	0.65
60	20	20	6	0.91221264E 00	0.13215283E 00	6.90	0.65
60	20						82.97
60	20		20	0.48202535E 09	0.24101267E 08	305.40	0.00000
60	20		1254	0.98962231E 08	0.78917249E 05		
60	20		1274	0.58098758E 09			
60	20			0.28092214E 03	0.37602000E 07	47.65	
60	20			0.58781095E-01			

60	21			0.35212174E 03			
60	21	1	13	0.76186221E 00	0.41564281E-01	18.33	47.74
60	21	2	1	0.45703585E 01	0.30319906E 00	15.07	7.02
60	21	3	8	0.90454562E 00	0.49657506E-01	18.22	4.69
60	21	4	20	0.62008584E 00	0.81362202E-01	7.62	3.52
60	21	5	12	0.64935173E 00	0.73271948E-01	8.86	3.10
60	21	6	2	0.89025866E 00	0.64022300E-01	13.91	2.20
60	21	7	16	0.56273470E 00	0.88815080E-01	6.34	1.82
60	21	8	15	0.76072960E 00	0.11423685E 00	6.66	1.48
60	21	9	3	0.75235790E 00	0.64996707E-01	11.58	1.28
60	21	10	9	0.72862379E 00	0.52304214E-01	13.93	1.07
60	21	11	10	0.61024607E 00	0.46848218E-01	13.03	1.12
60	21	12	7	0.10988271E 01	0.13520327E 00	8.13	1.45
60	21	13	19	0.12044702E 01	0.14334688E 00	8.40	1.01
60	21	14	4	0.74386094E 00	0.90418966E-01	8.23	0.98
60	21	15	14	0.12229351E 01	0.15336693E 00	7.97	0.78
60	21	16	18	0.10984311E 01	0.12021716E 00	9.14	0.74
60	21	17	17	0.73509556E 00	0.82365250E-01	8.92	0.89
60	21	18	11	0.87694696E 00	0.13294729E 00	6.60	0.79
60	21	19	28	0.64887971E 00	0.85943676E-01	7.55	0.65
60	21	20	6	0.90171264E 00	0.13090397E 00	6.89	0.65
60	21	21	27	0.62036932E 00	0.12317691E 00	5.04	0.34
60	21						83.30
60	21		21	0.48398896E 09	0.23047093E 08	297.72	0.00000
60	21		1253	0.96998619E 08	0.77413104E 05		
60	21		1274	0.58098758E 09			
60	21			0.27823211E 03	0.19636120E 07	25.37	
60	21			0.48936218E-01			

60	22			0.35246225E 03			
60	22	1	13	0.76204288E 00	0.41212506E-01	18.49	47.74
60	22	2	1	0.45799101E 01	0.30063958E 00	15.23	7.02
60	22	3	8	0.88257282E 00	0.49454805E-01	17.85	4.69
60	22	4	20	0.63949309E 00	0.80777329E-01	7.92	3.52
60	22	5	12	0.63175700E 00	0.72746489E-01	8.68	3.10
60	22	6	2	0.91535592E 00	0.63700711E-01	14.37	2.20
60	22	7	16	0.56863894E 00	0.88072168E-01	6.46	1.82
60	22	8	15	0.75140722E 00	0.11328703E 00	6.63	1.48
60	22	9	3	0.77819171E 00	0.64676480E-01	12.03	1.28
60	22	10	9	0.73662481E 00	0.51888965E-01	14.20	1.07
60	22	11	10	0.61170486E 00	0.46452722E-01	13.17	1.12
60	22	12	7	0.10412467E 01	0.13460782E 00	7.74	1.45
60	22	13	19	0.12228312E 01	0.14218636E 00	8.60	1.01
60	22	14	4	0.73785222E 00	0.89662632E-01	8.23	0.98
60	22	15	14	0.10082717E 01	0.15866485E 00	6.35	0.78
60	22	16	18	0.10926176E 01	0.11920597E 00	9.17	0.74
60	22	17	17	0.72990489E 00	0.81675463E-01	8.94	0.89
60	22	18	11	0.85495205E 00	0.13190364E 00	6.48	0.79
60	22	19	28	0.66747526E 00	0.85306460E-01	7.82	0.65
60	22	20	6	0.90442581E 00	0.12979728E 00	6.97	0.65
60	22	21	27	0.59656127E 00	0.12223753E 00	4.88	0.34
60	22	22	5	0.10074099E 01	0.21246250E 00	4.74	0.29
60	22						83.60
60	22		22	0.48570008E 09	0.22077276E 08	290.08	0.00000
60	22		1252	0.95287503E 08	0.76108229E 05		
60	22		1274	0.58098758E 09			
60	22			0.27587720E 03	0.17111160E 07	22.48	
60	22			0.42173205E-01			

60	23			0.35254663E 03			
60	23	1	13	0.75631054E 00	0.41032615E-01	18.43	47.74
60	23	2	1	0.46119144E 01	0.29923956E 00	15.41	7.02
60	23	3	8	0.89299774E 00	0.49284096E-01	18.12	4.69
60	23	4	20	0.65195889E 00	0.80437884E-01	8.11	3.52
60	23	5	12	0.61256514E 00	0.72561950E-01	8.44	3.10
60	23	6	2	0.90618424E 00	0.63425870E-01	14.29	2.20
60	23	7	16	0.55577700E 00	0.87694089E-01	6.34	1.82
60	23	8	15	0.74762531E 00	0.11271731E 00	6.63	1.48
60	23	9	3	0.77522130E 00	0.64353564E-01	12.05	1.28
60	23	10	9	0.74285501E 00	0.51653156E-01	14.38	1.07
60	23	11	10	0.61530574E 00	0.46227393E-01	13.31	1.12
60	23	12	7	0.94587296E 00	0.13636552E 00	6.94	1.45
60	23	13	19	0.12174024E 01	0.14147307E 00	8.61	1.01
60	23	14	4	0.74079696E 00	0.89211598E-01	8.30	0.98
60	23	15	14	0.10111275E 01	0.15786234E 00	6.41	0.78
60	23	16	18	0.10899204E 01	0.11860386E 00	9.19	0.74
60	23	17	17	0.72908710E 00	0.81261694E-01	8.97	0.89
60	23	18	11	0.83973304E 00	0.13129890E 00	6.40	0.79
60	23	19	28	0.64759018E 00	0.85042719E-01	7.61	0.65
60	23	20	6	0.82779925E 00	0.13077723E 00	6.33	0.65
60	23	21	27	0.60403658E 00	0.12163449E 00	4.97	0.34
60	23	22	5	0.10244295E 01	0.21143506E 00	4.85	0.29
60	23	23	30	0.79976101E 00	0.21535353E 00	3.71	0.18
60	23						83.78
60	23		23	0.48673912E 09	0.21162570E 08	280.90	0.00000
60	23		1251	0.94248463E 08	0.75338499E 05		
60	23		1274	0.58098758E 09			
60	23			0.27447860E 03	0.10390400E 07	13.79	
60	23			0.37666277E-01			

60	24			0.34653784E 03			
60	24	1	13	0.75875604E 00	0.40838093E-01	18.58	47.74
60	24	2	1	0.45287453E 01	0.29865361E 00	15.16	7.02
60	24	3	8	0.89641900E 00	0.49052817E-01	18.27	4.69
60	24	4	20	0.63608053E 00	0.80164190E-01	7.93	3.52
60	24	5	12	0.62406671E 00	0.72277118E-01	8.63	3.10
60	24	6	2	0.90970345E 00	0.63124054E-01	14.41	2.20
60	24	7	16	0.58170690E 00	0.87556035E-01	6.64	1.82
60	24	8	15	0.75242342E 00	0.11217554E 00	6.71	1.48
60	24	9	3	0.77870707E 00	0.64046980E-01	12.16	1.28
60	24	10	9	0.73751246E 00	0.51422239E-01	14.34	1.07
60	24	11	10	0.62143800E 00	0.46032786E-01	13.50	1.12
60	24	12	7	0.94574409E 00	0.13570075E 00	6.97	1.45
60	24	13	19	0.11722181E 01	0.14132806E 00	8.29	1.01
60	24	14	4	0.73896281E 00	0.88778118E-01	8.32	0.98
60	24	15	14	0.10034538E 01	0.15710687E 00	6.39	0.78
60	24	16	18	0.10586530E 01	0.11833696E 00	8.95	0.74
60	24	17	17	0.69208709E 00	0.81500120E-01	8.49	0.89
60	24	18	11	0.83586622E 00	0.13066313E 00	6.40	0.79
60	24	19	28	0.64466731E 00	0.84631936E-01	7.62	0.65
60	24	20	6	0.81913529E 00	0.13016140E 00	6.29	0.65
60	24	21	27	0.61495782E 00	0.12107860E 00	5.08	0.34
60	24	22	5	0.10385803E 01	0.21044013E 00	4.94	0.29
60	24	23	30	0.79906550E 00	0.21430377E 00	3.73	0.18
60	24	24	26	0.11776900E 01	0.32308574E 00	3.65	0.17
60	24						83.95
60	24		24	0.48773040E 09	0.20322100E 08	272.39	0.00000
60	24		1250	0.93257179E 08	0.74605742E 05		
60	24		1274	0.58098758E 09			
60	24			0.27314052E 03	0.99128399E 06	13.29	
60	24			0.35063718E-01			

60	25			0.34110542E 03			
60	25	1	13	0.75148028E 00	0.40736871E-01	18.45	47.74
60	25	2	1	0.45248754E 01	0.29747963E 00	15.21	7.02
60	25	3	8	0.90464968E 00	0.48923144E-01	18.49	4.69
60	25	4	20	0.63762771E 00	0.79849825E-01	7.99	3.52
60	25	5	12	0.63067561E 00	0.72020255E-01	8.76	3.10
60	25	6	2	0.91552826E 00	0.62900165E-01	14.56	2.20
60	25	7	16	0.58819330E 00	0.87233299E-01	6.74	1.82
60	25	8	15	0.75539206E 00	0.11173733E 00	6.76	1.48
60	25	9	3	0.78488786E 00	0.63822171E-01	12.30	1.28
60	25	10	9	0.72991704E 00	0.51271321E-01	14.24	1.07
60	25	11	10	0.61730042E 00	0.45868595E-01	13.46	1.12
60	25	12	7	0.87493398E 00	0.13685653E 00	6.39	1.45
60	25	13	19	0.11323243E 01	0.14128883E 00	8.01	1.01
60	25	14	4	0.74821586E 00	0.88472833E-01	8.46	0.98
60	25	15	14	0.99680449E 00	0.15650104E 00	6.37	0.78
60	25	16	18	0.10467332E 01	0.11792613E 00	8.88	0.74
60	25	17	17	0.69841323E 00	0.81201719E-01	8.60	0.89
60	25	18	11	0.82380925E 00	0.13019969E 00	6.33	0.79
60	25	19	28	0.63370114E 00	0.84363982E-01	7.51	0.65
60	25	20	6	0.81606364E 00	0.12965208E 00	6.29	0.65
60	25	21	27	0.60038035E 00	0.12068247E 00	4.97	0.34
60	25	22	5	0.10450161E 01	0.20962033E 00	4.99	0.29
60	25	23	30	0.80932235E 00	0.21348230E 00	3.79	0.18
60	25	24	26	0.11219956E 01	0.32225484E 00	3.48	0.17
60	25	25	24	0.11276615E 01	0.34147824E 00	3.30	0.14
60	25						84.09
60	25		25	0.48853759E 09	0.19541503E 08	264.01	0.00000
60	25		1249	0.92449991E 08	0.74019207E 05		
60	25		1274	0.58098758E 09			
60	25			0.27206471E 03	0.80718799E 06	10.91	
60	25			0.32439657E-01			

60	26			0.34234910E 03			
60	26	1	13	0.75051341E 00	0.40635283E-01	18.47	47.74
60	26	2	1	0.45224286E 01	0.29672773E 00	15.24	7.02
60	26	3	8	0.89159286E 00	0.49036356E-01	18.18	4.69
60	26	4	20	0.48404898E 00	0.97739399E-01	4.95	3.52
60	26	5	12	0.63252196E 00	0.71841115E-01	8.80	3.10
60	26	6	2	0.92441920E 00	0.62826549E-01	14.71	2.20
60	26	7	16	0.62433618E 00	0.88027835E-01	7.09	1.82
60	26	8	15	0.80100461E 00	0.11271718E 00	7.11	1.48
60	26	9	3	0.78991053E 00	0.63687515E-01	12.40	1.28
60	26	10	9	0.71910618E 00	0.51296730E-01	14.02	1.07
60	26	11	10	0.61704016E 00	0.45752548E-01	13.49	1.12
60	26	12	7	0.81695020E 00	0.13817538E 00	5.91	1.45
60	26	13	19	0.11366961E 01	0.14094029E 00	8.07	1.01
60	26	14	4	0.75421433E 00	0.88276538E-01	8.54	0.98
60	26	15	14	0.10124559E 01	0.15621147E 00	6.48	0.78
60	26	16	18	0.10233671E 01	0.11794287E 00	8.68	0.74
60	26	17	17	0.66103059E 00	0.82161497E-01	8.05	0.89
60	26	18	11	0.82573752E 00	0.12987195E 00	6.36	0.79
60	26	19	28	0.63798482E 00	0.84165191E-01	7.58	0.65
60	26	20	6	0.82579825E 00	0.12937361E 00	6.38	0.65
60	26	21	27	0.59535870E 00	0.12039113E 00	4.95	0.34
60	26	22	5	0.10665400E 01	0.20924022E 00	5.10	0.29
60	26	23	30	0.81630609E 00	0.21295730E 00	3.83	0.18
60	26	24	26	0.12170674E 01	0.32334618E 00	3.76	0.17
60	26	25	24	0.11207400E 01	0.34062313E 00	3.29	0.14
60	26	26	22	0.37406796E 00	0.13798150E 00	2.71	0.09
60	26						84.18
60	26		26	0.48907884E 09	0.18810725E 08	255.42	0.00000
60	26		1248	0.91908739E 08	0.73644822E 05		
60	26		1274	0.58098758E 09			
60	26			0.27137579E 03	0.54125199E 06	7.35	
60	26			0.17229571E-01			

60	27			0.33666603E 03			
60	27	1	13	0.75302550E 00	0.40551909E-01	18.57	47.74
60	27	2	1	0.44786384E 01	0.29650894E 00	15.10	7.02
60	27	3	8	0.88124708E 00	0.49081678E-01	17.95	4.69
60	27	4	20	0.48274392E 00	0.97512774E-01	4.95	3.52
60	27	5	12	0.63581525E 00	0.71684662E-01	8.87	3.10
60	27	6	2	0.92189566E 00	0.62687480E-01	14.71	2.20
60	27	7	16	0.62527395E 00	0.87823311E-01	7.12	1.82
60	27	8	15	0.81141665E 00	0.11252480E 00	7.21	1.48
60	27	9	3	0.78542701E 00	0.63562135E-01	12.36	1.28
60	27	10	9	0.70574586E 00	0.51431433E-01	13.72	1.07
60	27	11	10	0.60679518E 00	0.45813634E-01	13.24	1.12
60	27	12	7	0.82407332E 00	0.13788010E 00	5.98	1.45
60	27	13	19	0.11322628E 01	0.14062187E 00	8.05	1.01
60	27	14	4	0.73906800E 00	0.88260897E-01	8.37	0.98
60	27	15	14	0.98265552E 00	0.15626319E 00	6.29	0.78
60	27	16	18	0.10333372E 01	0.11772959E 00	8.78	0.74
60	27	17	17	0.67553643E 00	0.82157342E-01	8.22	0.89
60	27	18	11	0.82846674E 00	0.12957333E 00	6.39	0.79
60	27	19	28	0.64233703E 00	0.83985430E-01	7.65	0.65
60	27	20	6	0.83421782E 00	0.12911209E 00	6.46	0.65
60	27	21	27	0.60748738E 00	0.12019991E 00	5.05	0.34
60	27	22	5	0.10628038E 01	0.20875722E 00	5.09	0.29
60	27	23	30	0.80339591E 00	0.21251808E 00	3.78	0.18
60	27	24	26	0.11894304E 01	0.32276525E 00	3.69	0.17
60	27	25	24	0.11330264E 01	0.33986136E 00	3.33	0.14
60	27	26	22	0.37088791E 00	0.13766514E 00	2.69	0.09
60	27	27	21	0.48392249E 01	0.18502656E 01	2.62	0.09
60	27						84.27
60	27		27	0.48958026E 09	0.18132602E 08	247.37	0.00000
60	27		1247	0.91407327E 08	0.73301785E 05		
60	27		1274	0.58098758E 09			
60	27			0.27074302E 03	0.50141200E 06	6.84	
60	27			0.16237458E-01			

60	28			0.33750230E 03			
60	28	1	13	0.75470940E 00	0.40488931E-01	18.64	47.74
60	28	2	1	0.43715893E 01	0.29963602E 00	14.59	7.02
60	28	3	8	0.87641749E 00	0.49042405E-01	17.87	4.69
60	28	4	20	0.47871611E 00	0.97361168E-01	4.92	3.52
60	28	5	12	0.63777384E 00	0.71566700E-01	8.91	3.10
60	28	6	2	0.92123069E 00	0.62580562E-01	14.72	2.20
60	28	7	16	0.58373257E 00	0.89513216E-01	6.52	1.82
60	28	8	15	0.78716344E 00	0.11282541E 00	6.98	1.48
60	28	9	3	0.77806915E 00	0.63533620E-01	12.25	1.28
60	28	10	9	0.70174869E 00	0.51372562E-01	13.66	1.07
60	28	11	10	0.59801023E 00	0.45894184E-01	13.03	1.12
60	28	12	7	0.83065950E 00	0.13767324E 00	6.03	1.45
60	28	13	19	0.11020268E 01	0.14099457E 00	7.82	1.01
60	28	14	4	0.74674116E 00	0.88172543E-01	8.47	0.98
60	28	15	14	0.99800026E 00	0.15613757E 00	6.39	0.78
60	28	16	18	0.10490505E 01	0.11772589E 00	8.91	0.74
60	28	17	17	0.69617909E 00	0.82505829E-01	8.44	0.89
60	28	18	11	0.83237282E 00	0.12936210E 00	6.43	0.79
60	28	19	28	0.64451110E 00	0.83846618E-01	7.69	0.65
60	28	20	6	0.83490573E 00	0.12889085E 00	6.48	0.65
60	28	21	27	0.60290084E 00	0.12001018E 00	5.02	0.34
60	28	22	5	0.10545312E 01	0.20842997E 00	5.06	0.29
60	28	23	30	0.80544585E 00	0.21215522E 00	3.80	0.18
60	28	24	26	0.11676654E 01	0.32235020E 00	3.62	0.17
60	28	25	24	0.10988272E 01	0.33960367E 00	3.24	0.14
60	28	26	22	0.37597151E 00	0.13744664E 00	2.74	0.09
60	28	27	21	0.47490939E 01	0.18475056E 01	2.57	0.09
60	28	28	25	0.76383732E 00	0.33206092E 00	2.30	0.07
60	28						84.33
60	28		28	0.48996679E 09	0.17498814E 08	239.54	0.00000
60	28		1246	0.91020795E 08	0.73050396E 05		
60	28		1274	0.58098758E 09			
60	28			0.27027837E 03	0.38653200E 06	5.29	
60	28			0.13743290E-01			

60	29			0.33585037E 03			
60	29	1	13	0.73926778E 00	0.41187925E-01	17.95	47.74
60	29	2	1	0.44021906E 01	0.29968564E 00	14.69	7.02
60	29	3	8	0.85692331E 00	0.49966312E-01	17.15	4.69
60	29	4	20	0.47006351E 00	0.97345800E-01	4.83	3.52
60	29	5	12	0.62431425E 00	0.71806153E-01	8.69	3.10
60	29	6	2	0.92806064E 00	0.62602763E-01	14.82	2.20
60	29	7	16	0.58407620E 00	0.89408890E-01	6.53	1.82
60	29	8	15	0.80738615E 00	0.11315630E 00	7.14	1.48
60	29	9	3	0.77750805E 00	0.63460086E-01	12.25	1.28
60	29	10	9	0.68794117E 00	0.51785018E-01	13.28	1.07
60	29	11	10	0.56055058E 00	0.49596903E-01	11.30	1.12
60	29	12	7	0.82736430E 00	0.13752261E 00	6.02	1.45
60	29	13	19	0.11143555E 01	0.14096778E 00	7.91	1.01
60	29	14	4	0.74946926E 00	0.88080406E-01	8.51	0.98
60	29	15	14	0.10027542E 01	0.15597381E 00	6.43	0.78
60	29	16	18	0.10711641E 01	0.11811849E 00	9.07	0.74
60	29	17	17	0.70086319E 00	0.82443515E-01	8.50	0.89
60	29	18	11	0.83038841E 00	0.12921498E 00	6.43	0.79
60	29	19	28	0.63818032E 00	0.83809845E-01	7.61	0.65
60	29	20	6	0.83961050E 00	0.12876235E 00	6.52	0.65
60	29	21	27	0.62002531E 00	0.12018217E 00	5.16	0.34
60	29	22	5	0.10434798E 01	0.20826158E 00	5.01	0.29
60	29	23	30	0.79631032E 00	0.21195786E 00	3.76	0.18
60	29	24	26	0.11987289E 01	0.32235650E 00	3.72	0.17
60	29	25	24	0.10825237E 01	0.33930730E 00	3.19	0.14
60	29	26	22	0.39304940E 00	0.13755729E 00	2.86	0.09
60	29	27	21	0.43056913E 01	0.18589085E 01	2.32	0.09
60	29	28	25	0.73453129E 00	0.33200388E 00	2.21	0.07
60	29	29	23	0.46936007E 00	0.23723663E 00	1.98	0.05
60	29						84.38
60	29		29	0.49025206E 09	0.16905243E 08	231.96	0.00000
60	29		1245	0.90735527E 08	0.72879941E 05		
60	29		1274	0.58098758E 09			
60	29			0.26996285E 03	0.28526800E 06	3.91	
60	29			0.75409188E-02			

60	30			0.33361948E 03			
60	30	1	13	0.73998247E 00	0.41156792E-01	17.98	47.74
60	30	2	1	0.44028153E 01	0.29944433E 00	14.70	7.02
60	30	3	8	0.85824894E 00	0.49931890E-01	17.19	4.69
60	30	4	20	0.46612461E 00	0.97293847E-01	4.79	3.52
60	30	5	12	0.62249496E 00	0.71755947E-01	8.68	3.10
60	30	6	2	0.92825121E 00	0.62552405E-01	14.84	2.20
60	30	7	16	0.59517214E 00	0.89565527E-01	6.65	1.82
60	30	8	15	0.81593672E 00	0.11317250E 00	7.21	1.48
60	30	9	3	0.77898507E 00	0.63414657E-01	12.28	1.28
60	30	10	9	0.68756943E 00	0.51743726E-01	13.29	1.07
60	30	11	10	0.56094880E 00	0.49557463E-01	11.32	1.12
60	30	12	7	0.80594054E 00	0.13796564E 00	5.84	1.45
60	30	13	19	0.10956441E 01	0.14126657E 00	7.76	1.01
60	30	14	4	0.74905510E 00	0.88009743E-01	8.51	0.98
60	30	15	14	0.10013068E 01	0.15585034E 00	6.42	0.78
60	30	16	18	0.10662187E 01	0.11805772E 00	9.03	0.74
60	30	17	17	0.69233643E 00	0.82523589E-01	8.39	0.89
60	30	18	11	0.80874267E 00	0.12971241E 00	6.23	0.79
60	30	19	28	0.64373749E 00	0.83803553E-01	7.68	0.65
60	30	20	6	0.85320633E 00	0.12889707E 00	6.62	0.65
60	30	21	27	0.61013696E 00	0.12022053E 00	5.08	0.34
60	30	22	5	0.10415478E 01	0.20809672E 00	5.01	0.29
60	30	23	30	0.78974170E 00	0.21182088E 00	3.73	0.18
60	30	24	26	0.11550398E 01	0.32307984E 00	3.58	0.17
60	30	25	24	0.10606554E 01	0.33926814E 00	3.13	0.14
60	30	26	22	0.40748017E 00	0.13769795E 00	2.96	0.09
60	30	27	21	0.44137788E 01	0.18584551E 01	2.37	0.09
60	30	28	25	0.65415487E 00	0.33495646E 00	1.95	0.07
60	30	29	23	0.48580934E 00	0.23723502E 00	2.05	0.05
60	30	30	32	0.57313461E 00	0.33039129E 00	1.73	0.04
60	30						84.42
60	30		30	0.49047101E 09	0.16349034E 08	224.69	0.00000
60	30		1244	0.90516571E 08	0.72762516E 05		
60	30		1274	0.58098758E 09			
60	30			0.26974528E 03	0.21895600E 06	3.01	
60	30			0.69552139E-02			

60	31			0.33267364E 03			
60	31	1	13	0.74036051E 00	0.41136950E-01	18.00	47.74
60	31	2	1	0.43946890E 01	0.29934343E 00	14.68	7.02
60	31	3	8	0.85853879E 00	0.49907254E-01	17.20	4.69
60	31	4	20	0.45152200E 00	0.97731786E-01	4.62	3.52
60	31	5	12	0.62381315E 00	0.71725396E-01	8.70	3.10
60	31	6	2	0.92988348E 00	0.62530555E-01	14.87	2.20
60	31	7	16	0.59478269E 00	0.89521041E-01	6.64	1.82
60	31	8	15	0.81388568E 00	0.11312408E 00	7.19	1.48
60	31	9	3	0.78044497E 00	0.63390375E-01	12.31	1.28
60	31	10	9	0.68871577E 00	0.51723462E-01	13.32	1.07
60	31	11	10	0.56142081E 00	0.49533640E-01	11.33	1.12
60	31	12	7	0.80106269E 00	0.13793492E 00	5.81	1.45
60	31	13	19	0.10937644E 01	0.14120138E 00	7.75	1.01
60	31	14	4	0.75058101E 00	0.87971549E-01	8.53	0.98
60	31	15	14	0.10061866E 01	0.15580628E 00	6.46	0.78
60	31	16	18	0.10605918E 01	0.11805827E 00	8.98	0.74
60	31	17	17	0.69719326E 00	0.82545861E-01	8.45	0.89
60	31	18	11	0.81122302E 00	0.12965799E 00	6.26	0.79
60	31	19	28	0.64386023E 00	0.83761616E-01	7.69	0.65
60	31	20	6	0.84272571E 00	0.12902207E 00	6.53	0.65
60	31	21	27	0.60219754E 00	0.12027697E 00	5.01	0.34
60	31	22	5	0.10436877E 01	0.20799738E 00	5.02	0.29
60	31	23	30	0.79513134E 00	0.21174531E 00	3.76	0.18
60	31	24	26	0.11683437E 01	0.32303994E 00	3.62	0.17
60	31	25	24	0.10684976E 01	0.33913855E 00	3.15	0.14
60	31	26	22	0.42329330E 00	0.13803264E 00	3.07	0.09
60	31	27	21	0.44341971E 01	0.18575742E 01	2.39	0.09
60	31	28	25	0.66073173E 00	0.33481742E 00	1.97	0.07
60	31	29	23	0.49006561E 00	0.23713319E 00	2.07	0.05
60	31	30	32	0.57894452E 00	0.33024854E 00	1.75	0.04
60	31	31	29	0.29827200E 01	0.19897207E 01	1.50	0.03
60	31						84.45
60	31		31	0.49063436E 09	0.15826915E 08	217.73	0.00000
60	31		1243	0.90353227E 08	0.72689643E 05		
60	31		1274	0.58098758E 09			
60	31			0.26961017E 03	0.16334400E 06	2.25	
60	31			0.67807282E-02			

60	32			0.33269453E 03			
60	32	1	13	0.74029187E 00	0.41152982E-01	17.99	47.74
60	32	2	1	0.43966325E 01	0.29953683E 00	14.68	7.02
60	32	3	8	0.85875362E 00	0.49931822E-01	17.20	4.69
60	32	4	20	0.45192720E 00	0.97779043E-01	4.62	3.52
60	32	5	12	0.62504792E 00	0.71890340E-01	8.69	3.10
60	32	6	2	0.93002323E 00	0.62555825E-01	14.87	2.20
60	32	7	16	0.59514416E 00	0.89563813E-01	6.64	1.82
60	32	8	15	0.81426349E 00	0.11317434E 00	7.19	1.48
60	32	9	3	0.78092425E 00	0.63437522E-01	12.31	1.28
60	32	10	9	0.68883398E 00	0.51744441E-01	13.31	1.07
60	32	11	10	0.56162902E 00	0.49557747E-01	11.33	1.12
60	32	12	7	0.80160194E 00	0.13799991E 00	5.81	1.45
60	32	13	19	0.10937222E 01	0.14125393E 00	7.74	1.01
60	32	14	4	0.75025804E 00	0.88011959E-01	8.52	0.98
60	32	15	14	0.10033745E 01	0.15619434E 00	6.42	0.78
60	32	16	18	0.10600777E 01	0.11811672E 00	8.97	0.74
60	32	17	17	0.69671387E 00	0.82594662E-01	8.44	0.89
60	32	18	11	0.81059154E 00	0.12972620E 00	6.25	0.79
60	32	19	28	0.64345915E 00	0.83805246E-01	7.68	0.65
60	32	20	6	0.84283232E 00	0.12907059E 00	6.53	0.65
60	32	21	27	0.60224169E 00	0.12032177E 00	5.01	0.34
60	32	22	5	0.10549850E 01	0.21203276E 00	4.98	0.29
60	32	23	30	0.79797607E 00	0.21207272E 00	3.76	0.18
60	32	24	26	0.11696108E 01	0.32319234E 00	3.62	0.17
60	32	25	24	0.10693564E 01	0.33927874E 00	3.15	0.14
60	32	26	22	0.42286642E 00	0.13809253E 00	3.06	0.09
60	32	27	21	0.44410315E 01	0.18584282E 01	2.39	0.09
60	32	28	25	0.66109269E 00	0.33494438E 00	1.97	0.07
60	32	29	23	0.48834140E 00	0.23730294E 00	2.06	0.05
60	32	30	32	0.57818661E 00	0.33038259E 00	1.75	0.04
60	32	31	29	0.29802208E 01	0.19904805E 01	1.50	0.03
60	32	32	33	-0.35927988E 00	0.12968236E 01	-0.28	0.00
60	32						84.45
60	32		32	0.49063993E 09	0.15332498E 08	210.77	0.00000
60	32		1242	0.90347647E 08	0.72743677E 05		
60	32		1274	0.58098758E 09			
60	32			0.26971035E 03	0.55800000E 04	0.08	
60	32			0.64347716E-02			

SUMMARY STATISTICS ON RESIDUALS

SUM OF RESIDUALS	0.38521805E 01
SUM OF SQUARES OF RESIDUALS	0.90350448E 08
MEAN OF RESIDUALS	0.30213180E-02
STANDARD DEVIATION OF RESIDUALS	0.26630569E 03
DURBIN-WATSON STATISTIC	0.11068359E 01
CORRELATION OF RESIDUALS	0.44616 0.35388 0.44569 0.19351
NUMBER OF RUNS	432
POSITIVE SIGNS	600
NEGATIVE SIGNS	675
MEAN	0.63629411E 03
STANDARD DEVIATION	0.17784761E 02
COEFFICIENT OF SKEWNESS	0.20402475E 00
STANDARD DEVIATION	0.68518912E-01
COEFFICIENT OF KURTOSIS	0.20501981E 01
STANDARD DEVIATION	0.13693106E 00

APPENDIX 3

CONTROLS ON THE

GENERATION AND CLASSIFICATION

OF THE DATA

APPENDIX 3

ELDORADO MINING AND REFINING

STOPE CONTRACT RATES

February 1962 - November 1964

GENERAL

All the following quantities will be based on engineering figures. Tonnage broken will be calculated on the basis of 12 cu. ft./ton.

Contractors are required to maintain timber work in and around their working places.

Contractors are responsible for the cleaning up of backfill spill when caused by poor timbering practices.

BREAKING

Width (Ft.)	Rate/Ton	Amex Allowance Lbs./Ton	High Explosive Allowance
0 - 4	1.20	6.0	
4 - 6	.67	3.0	
6 - 10	.48	1.5	0.33 lbs./fuse
10 - 20	.42	1.1	
Over 20	.39	0.8	
Slashing (except breast equivalent)	.48	1.5	
Subdrifting (Basic)	6.90/ft.	12.0/ft.	3.0 lbs./ft
Stope Crew Raising	-	-	815 lbs./ft.
Block Holing & Chute Blasting		-	As required

BREAKING - (continued)

1. Fuse, caps and Thermalite to be charged at the usual rates.

2. No charge for powder used up to the maximum allowance.

3. When the maximum allowance has been exceeded, the excess over the maximum allowance will be charged to the contract at the following rates:

Amex	- 0.15/lb.
Digel or Cilgel	- 0.30/lb.

4. The price for subdrifting will increase $0.50/ft. for each 50 feet increase in scraping distance.

SLUSHING

Slushing	Primary	Secondary One Slusher	Secondary Two Slushers
5 H.P. Air Slusher	$0.60 Per Ton	$0.20 Per Ton	$0.15 Per Ton
10 H.P. Air Slusher	0.50 " "	0.20 " "	0.15 " "
Electric Slusher	0.40 Per Ton	0.20 Per Ton	0.15 Per Ton

STOPE TIMBERING

Manway and Millholes (complete with Bulkhead)

Stulled (30% each side and 10% for lining)	$13.50 Per Ft.
Cribbed (30% each side and 10% for lining)	15.00 Per Ft.
In Square Set Stopes	5.00 Per Ft.

STOPE TIMBERING - (continued)

Gob Fence	$ 0.30 Per Sq. Ft.
Hangingwall Fill Fence	0.30 Per Sq. Ft.
Sill Fence	0.25 Per Sq. Ft.
Stope Fence or Drift Wall Fence	0.20 Per Sq. Ft.
Pillar Fence	0.40 Per Sq. Ft.
Slusher Floor - 0 - 7' wide, 14" spacing	0.12 Per Sq. Ft.
Slusher Floor - 7' up wide, 14" spacing	0.10 Per Sq. Ft.
Slusher Floor - less than 14" spacing	0.12 Per Sq. Ft.
Sill or Lagging Floor	0.18 Per Sq. Ft.
Test Holes	0.75 Each
Permanent Posts with Squeeze Block	2.50 Each
Crib Back Support 4' x 4'	3.00 Per Ft.
Permanent Bulkheads	0.40 Per Sq.Ft.
Bearer Sets for Manway and Millhole	8.00 Each
"A" Sets	8.00 Per Set
Boom	3.00 Each
Square Sets	10.00 Each
Bracing Sets	1.00 Each
Rockbolts - Hand installed w/Plank	3.50 Each 12.2.59
Rockbolts - Hand installed no Plank	2.50 Each
Rockbolts - Machine installed w/Plank	2.00 Each
Rockbolts - Machine installed no Plank	1.25 Each

TABLE 1

VARIABLE LISTING FOR STOPE CONTRACT RECORDS DATA

Variable No.	Description	Units of Measurement
1.	Credit Time	hours
2.	Subdrifting 0' - 50' from millhole	feet
3.	Subdrifting 50' - 100' from millhole	*feet
4.	Subdrifting 100' - 150' from millhole	feet
5.	Subdrifting + 150' from millhole	feet
6.	Stope raising	feet
7.	Ore broken 4' - 6' widths	*tons
8.	Ore broken 6' - 10' widths	tons
9.	Ore broken 10' - 20' widths	tons
10.	Ore broken + 20' widths	tons
11.	Slushing with 5 HP air slushers	tons
12.	Slushing with 10 HP air slushers	tons
13.	Slushing with Electric slushers	tons
14.	Secondary slushing	*tons
15.	Slusher floor 0' - 7' widths	*square feet
16.	Slusher floor + 7' widths	*square feet
17.	Cribbed millhole	lineal feet
18.	Stulled millhole	lineal feet
19.	Gob fence	*square feet
20.	Hangingwall fence	square feet
21.	Test holes	each
22.	Rockbolts with plates	each
23.	Rockbolts plain	each
24.	Posts	each
25.	Cribbing	feet
26.	Bulkhead	square feet
27.	Tramming	tons
28.	Muck and tram	*tons
29.	Miscellaneous Development	dollars
30.	Miscellaneous Ore Breaking	*dollars
31.	Miscellaneous Slushing	dollars
32.	Miscellaneous Timber Work	*dollars
33.	Miscellaneous Credit	dollars
34.	Contract Time	hours
35.	Number of Workmen on Contract	each
36.	Number of Blastholes Drilled	each
37.	Number of Ream Holes Drilled	each
38.	Explosives Use Reported by Workmen	pounds
39.	High Explosives as Calculated by Supervision	pounds
40.	Amex as Calculated by Supervision	pounds
41.	Incentive Rate	dollars/hr.
42.	Penalty Charges	*dollars

NOTE: For variables marked * see notes taken during data preparation Appendix 3, page 5.

NOTES ON CONTRACT INFORMATION

1. Major part of Miscellaneous Breaking is Breasting @ $1.20/Ton (-4' wide) and $1.30/Ton.

2. Mucking and tramming @ .38¢ includes a proportion @ .43¢ and some @ .25¢.

3. Slusher Floor @ .12¢ and .10¢ - price and small method change in early 1963 put most of floor @ .10¢. Prior to this it was .12¢.

4. The major penalty charges less than $12.00 are for lost bits, pipe wrenches, tools etc. Charges in excess of $12.00 usually include some charge for excess powder usage - High explosive.

5. Breaking @ .48¢ includes all slashing as well as 6' - 10' widths breasted.

6. Double slush @ .20¢ includes some double slush @ .15¢.

7. Miscellaneous timber includes Bearer Timbers @ $8.00 each.

Manway	@	$1.00/Ft.
Slide	@	0.50/Ft.
Planking	@	0.15/Sq.Ft.
A sets	@	8.00 Each
Stulls	@	8.00 Each

8. Stopes such as 744 where square setting is done are not included in the data. Also much of 964, where the major work has been for development for long hole stoping.

9. Gob fence @ .30¢ includes some Sill Fence @ .25¢/Sq.Ft.

10. Some Rse @ $7.65/Ft. included in S. Dr. @ $7.40/Ft.

TABLE 2

CLASSIFICATION SYSTEMS FOR STOPING CONTRACT RECORDS

I. Classification by Mining Method - (based on the judgment of the Chief Engineer)

A. Standard Hangingwall cut and fill, average longitudinal 10' cuts at right angles to the hangingwall with cribbed mill holes, hangingwall rockbolts. Hangingwall fences and floor on each lift.

B. Fay & Verna type footwall cut and fill; Longitudinal 10' cuts at right angles to the hangingwall. Stulled and cribbed mill holes, some hangingwall fences, floor on each lift. Irregular footwall requires some subdrifting and slashing.

C. Verna type cut and fill. Irregular, generally flatter, dipping orebodies mined, by open pillar stoping methods through footwall boxholes. Filling done here mainly for ground support after a section has been mined up to a higher boxhole. Flooring is relatively small and much gob and hangingwall fences are used to close off filled areas.

D. Fay West open stoping. Ore bodies similar to C but are smaller, more erratic and steeper. Mining method is similar except that often a complete orebody is extracted before filling.

E. Open track-level stoping. Used for isolated ore bodies and remnants. Ore is mined by open stoping with posts and pillars. Ore is slushed down and mucked into cars at track level.

F. Static shrink. Stope is mined similar to Fay West open stopes but sufficient ore is kept in the stope to provide a working floor. On completion of breaking, the ore is slushed out to level chutes with rockbolts and posts used as ground control. The empty stope may or may not be filled.

TABLE 2 (Continued)

II. Classification by Ore Control. (based on judgment of Mine Staff)

Regular	=	1
Good	=	2
Erratic	=	3

III. Classification by Ground Control. (based on judgment of Mine Staff)

Normal	=	1
Heavy Hangingwall	=	2
Heavy back	=	3

IV. Classification by Ore Breaking Characteristics. (based on judgment of Mine Staff)

Easy	=	1
Normal	=	2
Hard	=	3

V. Classification by Time Periods. (Given in C.C. 7, 8, 9 of all data records)

Data can be sorted into month and year time intervals.

VI. Classification by Level of Incentive or Bonus Payments. (Given in C. C. 61 - 70 of data record 6)

Data was sorted into classes of $0.50/hr. increments.

LIST OF WORKING PLACES

SAMPLED FOR REGRESSION ANALYSIS

FEBRUARY 1962 - NOVEMBER 1964

Working Place No.	No. of Cont. Rec. Jan./63 Jun./64	Feb./62 Nov./64	Mining Method	Ore Control	Ground Control	Breaking
0243	12	16	E	3	1	2
0255	3	3	E	3	1	2
0248		1	D	3	1	1
0253		1	F(S)	3	?	?
0293		1	E(S)	3	3	2
0304		1	B(S)	1	2	2
0343	14	31	E	3	1	2
0355	12	17	F	3	1	2
0374		3	C	3	1	2
0381		2	E	3	1	2
0385		8	C	3	1	2
0443		10		1	3	2
0455	30	38	D	3	1	2
0477	15	23	C	3	1	2
0457		1	F	1	1	2
0473		9	E	3	1	2
0501		3	A	1	2	2
0543	5	8	D	1	3	2
0578	33	43	B	1	3	2
0581	26	40	B	1	3	2
0586	19	32	C	3	1	2
0593	2	2	?(S)			
0597	10	18	B	?		
0594		6	C	3	1	2
0632		1	?(S)			
0606		1	B(S)	1	2	2
0616		1	B(S)	1	1	2
0672	7	14	C(S)		1	2
0673	8	13	B		1	2
0644		1	B		3	2

LIST OF WORKING PLACES - (Continued)

Working Place No.	No. of Cont. Rec. Jan./63 June./64	Feb./62 Nov./64	Mining Method	Ore Control	Ground Control	Breaking
0678		4	B		3	2
0681		8	B		3	2
0686		4	B		3	2
0689		2	B		1	2
0697		2	B		1	2
0773	19	67	B		1	2
0774	2	7	?(S)			
0776	12	17	E		1	2
0744	1	6	B		3	2
0801	32	36	A		2	2
0809	6	36	B		1	2
0873	20	34	B		1	2
0876	18	27	C		1	2
0879	8	16	C		1	2
0826		1	?(S)			
0916		4	B S		2	2
0903		1				
0901		13	A		1	2
0909	15	51	B		1	2
0944	18	33	B		3	2
0961	11	11	B		1	2
0964	12	16	D		1	2
0965	8	13	B		2	2
0973	73	152	C		1	2
0976	34	49	C		1	2
0979	47	77	C		1	2
0973		1	?(S)			
0972		1	?(S)			
1001	3	8	A		2	2
1009	18	37	B		1	2

LIST OF WORKING PLACES - (Continued)

Working Place No.	No. of Cont. Rec. Jan./63 June/64	Feb./62 Nov./64	Mining Method	Ore Control	Ground Control	Breaking
1101	28	51	A		2	2
1109	7	17	B		1	2
1201		8	A		2 & 3	2
1209	36	57	B		3	2
1301	1	12	A		2	2
1309	30	42	B		3	2
1401	5	5	A	1	2	2
1409		1	B	1	1	2
	660	1,275				

TABLE 3

KEY TO COMPUTER OUTPUT OF MULTIPLE REGRESSION PROGRAMS

(Program 60 Appendix 2 used as an Example)

Page 1

Means, Variances and Standard Deviations

Line 1 - Col 1 - Program No. = 60
Col 2 - Variable No. = 1
Col 3 - Mean Variable No. 1 = 0.88730290 E 01
= 8.8730290
Col 4 - Variance of Variable No. 1 = 779.32906
Col 5 - Standard deviation of Variable No. 1 = 27.916466

Pages 2 - 4

Simple Correlation Coefficients

Page 2

Line 1 - Col 1 - Program No. = 60
Col 2) Col 3) - Variable No. notation

Col 4 - r_{12})
Col 5 - r_{13})
Col 6 - r_{14})
Col 7 - r_{15})
Col 8 - r_{16})
Col 9 - r_{17})

Where r_{ij} indicates the simple correlation of variable "i" with variable "j"

Pages 5 - 24 Regression Coefficients and Analysis of Variance

Page 5 - The bottom 11 lines - Regression Step 4

Col 1 - Program No. = 60
Col 2 - Step No. = 4 - Regression Statistics - Step 4
Col 3 - Lines 2, 3, 4 and 5 - Order of entry of variables into the regression = 1,2,3,4.

TABLE 3 (continued)

(program 60 Appendix 2 used as an Example

Page 5 - continued

Col 4 - lines 2, 3, 4, and 5 - No. of the variables which were entered into the regression 1st, 2nd, 3rd, and 4th

Col 5 - line 1 - Estimated coefficient of X_o, b_o

= $795.96090

- line 2 - Estimated coefficient of X_{13}, b_{13}

= 1.0389676

- line 3 - Estimated coefficient of X_1, b_1

= 6.7959579

- line 4 - Estimated coefficient of X_8, b_8

= 0.75326410

- line 5 - Estimated coefficient of X_{20}, b_{20}

= 1.1705417

Col 6 - lines 2 - 5 - Standard errors of estimate of the coefficients in Col 5.

Col 7 - lines 2 to 5 = Col 5 - Col 6 = $t_{a(4)}$
a = 13, 1, 8, 20

Col 8 - lines 2 to 5 = Percentage variance reduction due to the addition of variable 13, 1, 8 & 20 reduction due to the addition of variables 13, 1, 8 and 20

- line 6 = Total of the percentage variance reductions.

TABLE 3 (continued)

(Program 60 Appendix 2 used as an Example

Page 5 - continued

Analysis of Variance - Step 4

Col 4 - line 7 = No. of parameters in regression
= P = 4
= Degrees of freedom for regression

- line 8 = Degrees of freedom for error
= N-P-1
= 1270
(N = number of observations)

- line 9 = Total degrees of freedom
= N-1
= 1274

Col 5 - line 7 = Sum of squares for regression
= 365,779,400.0

- line 8 - Sums of squares for error
= 215,208,180.0

- line 9 - Total sums of squares
= 580,987,580.0

- line 10 - The standard error of the dependent variable
= s_n = \$411.64944

- line 11 - The determinant of the submatrix formed by simple correlation coefficients of the variables entered in the regression (13, 1, 8 and 20)

col 6 - line 7 - The estimated mean square for regression
= 91,444,850.0 (Col 5 ÷ Col 4)

TABLE 3 (continued)

(Program 60 Appendix 2 used as an Example

Page 5 - continued

Col 6 - line 8 - The estimated mean square for error
= 169,455.26 (Col 5 ÷ Col 4)

- line 10 - The sum of squares for regression in step 4 less the sum of squares for regression in the preceding step
= 20,435,684.0
= 365,779,400. - 345,343,720.

Col 7 - line 7 - "F_4" ratio = 539.64

- line 10 - "t_4" = 120.60

Col 8 - line 7 - Probability that "F" could be equal to zero: 0.00000

Page 25 - Summary Statistics on Residual

All statistics are identified on the left except the "Correlation of Residuals" which are in the order r_{xy}, r_{xz}, r_{yz}, and $r_{xz.y}$ where x, y and z refer to the sequences

$$x = (R_1, R_2, \ldots\ldots, R_{n-2})$$

$$y = (R_2, R_2, \ldots\ldots, R_{n-1})$$

$$z = (R_3, R_4, \ldots\ldots, R_n)$$

APPENDIX 4

COVARIANCE ANALYSIS OF MULTIPLE REGRESSION ON CLASSIFICATIONS OF STOPE CONTRACT DATA

APPENDIX 4

COVARIANCE ANALYSIS OF MULTIPLE REGRESSION ON CLASSIFICATIONS OF STOPE CONTRACT DATA

(Reference - Bennett & Franklin, "Statistical Analysis in Chemistry and the Chemical Industry" pp. 457 - 461)

GIVEN: Stope contract data representing a number of fixed measurements, X_{ij} on a variate Y_i have been classified into "p" classifications. Multiple regressions have been performed on the individual classifications and the full set. The residual sum of squares at the completion of the full regression has been calculated in all cases.

REQUIRED: Find if, on the whole, the classifications differ significantly from the full set as regards to the variability remaining after the same parameter multiple regression has been performed.

METHOD:

Source of Estimate	Analysis of Covariance Multiple Regression Corrected Sum of Squares	D.F.
Between Classes	$R_T^2 - \sum_p R_p^2$	P - 1
Within Classes	$\sum_p R_p^2$	N - n - p
Total	R_T^2	

<u>METHOD</u> - (continued

Where R_p^2 = residual sum of squares after fitting of "n" parameter regression function to the p^{th} classification.

R_T^2 = residual sum of squares after fitting of "n" classification.

N = total number of observations

TABLE 6

ANALYSIS OF COVARIANCE

TIME SERIES CLASSIFICATION (PROGRAMS 81 - 87, 60)

Source of Variation	Corrected Sums of Squares	D F	MS
Between Classes	14,789,877.3	6	2,464,969.6
Within Classes	75,560,630.7	1236	61,133.2
Total	90,350,448.0		

$F\ (6,1236) = 40.32$

TABLE 7

ANALYSIS OF COVARIANCE

MINING METHOD CLASSIFICATION

(Programs 60 - 67)

Source of Variation	Corrected Sums of Squares	D F	MS
Between Classes	20,588,849.4	6	3,431,474.8
Within Classes	69,761,598.6	1236	56,441.4
Total	90,350,448.0		

F (6,1236) = 60.80

TABLE 8

ANALYSIS OF COVARIANCE

INCENTIVE RATE CLASSIFICATION

(Programs 60, 70 - 77)

Source of Variation	Corrected Sums of Squares	D F	MS
Between Classes	75,179,317.7	7	10,739,902
Within Classes	15,171,130.3	1235	12,284
Total	90,350,448.0		

F (7,1225) = 8,743.0